CENTRAL ASIA NATURAL RESOURCES MANAGEMENT PROGRAM
TRANSBOUNDARY WATER AND ENERGY PROJECT

ELECTRICITY LOSS REDUCTION DEMONSTRATION PROJECTS

FINAL PERFORMANCE MONITORING RESULTS FOR DISTRIBUTION SECTOR

Central Asia Natural Resource Management Project
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LIST OF ACRONYMS

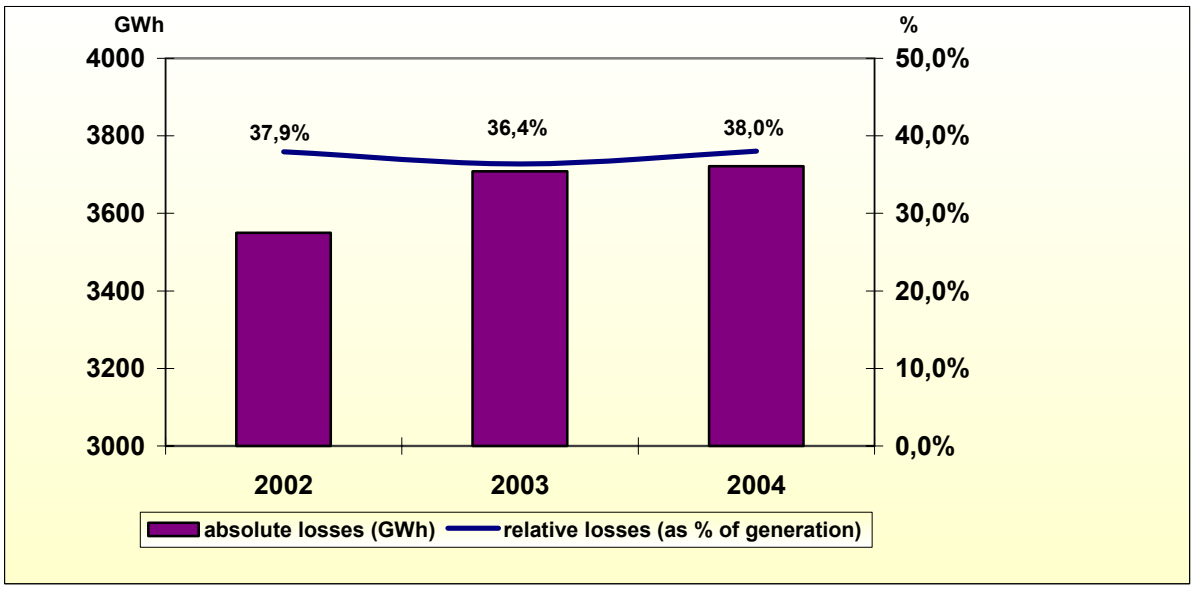
KfW	Kreditanstalt fur Wiederaufbau Germany
kV	Kilovolt
kW	Kilowatt
kWh	Kilowatt hour
NRMP	Central Asia Natural Resources Management Program
SEA	State Energy Agency
SECO	Switzerland State Secretariat for Economic Affairs
TWEP	Transboundary Water and Energy Project
USAID	United States Agency for International Development
DFID	Department for International Development
MBC	Metering, Billing and Collection
IRR	Internal Rate of Return

1. BACKGROUND

The Kyrgyz Republic energy sector continues to suffer serious problems. High electricity losses coupled with low level of revenue collection and overall inefficient management threaten the energy security of the country. The power sector of Kyrgyzstan continues to lose approximately $50 million of its expected revenues per year through unmetered consumption and low rate of collections due to poor management, inadequate internal controls, a weak regulatory regime, and a lack of regulatory enforcement.

Figure 1 shows the level of electricity losses in the distribution sector of the Kyrgyz Republic. Regardless of enforcement policies and loss reduction campaigns undertaken by the government of Kyrgyzstan, distribution losses continue to grow. During the period of observation from 2002 to 2004, distribution losses increased by 5% and, in absolute numbers, reached 3,722 million kWh or 38% of the total electricity input to the distribution networks. Considering that reasonable technical losses for the distribution networks of Kyrgyz Republic are deemed to be in the range of 10 to 13 %, the conclusion is that only 75% of electricity actually consumed by the end-users is metered and billed and only 86% of billing is collected. Overall only 64.5% of expected revenues is collected, out of which 37% is in barter and set-offs.

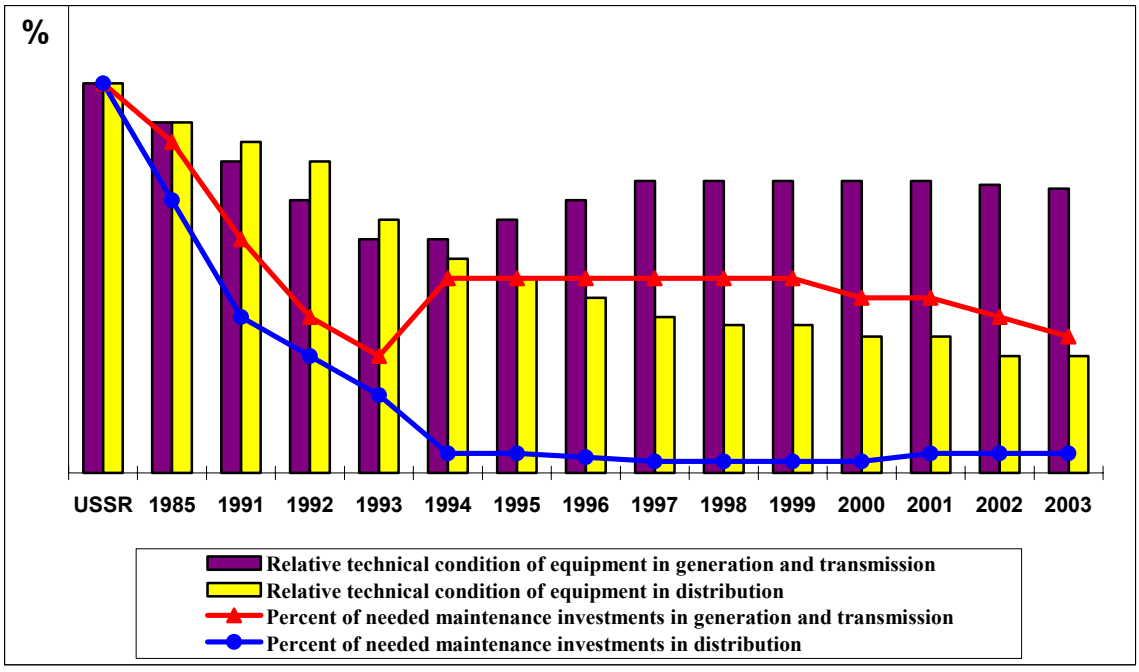
Figure 1. Distribution Electricity Losses in the Kyrgyz Republic (2002-2004)



The lack of cash in the sector results in a very low level of maintenance of the main equipment. The distribution infrastructure continues to deteriorate, resulting in more frequent power outages and increased technical losses. The low level of operating and maintenance budgets prevents distribution companies from procuring and maintaining a sufficient number of end-use meters, which results in a large number of unmetered customers. Quite often, such customers are not even registered with the companies. It is a downward spiral: the less the company spends on metering infrastructure, the less it collects; and therefore, the less revenue it has to improve said infrastructure.

The Department for International Development of the United Kingdom (DFID) performed an assessment of the technical conditions of equipment and investments in generation, transmission, and distribution. Figure 2 illustrates the progressive deterioration of distribution equipment, which reached 65% of its original technical condition with almost no investments and only emergency maintenance. Generation and transmission assets are in better condition due to the loans and grants provided by the international donor community and to generally better management of those companies.

Figure 2. Illustrative Graph of the Technical Condition of the Power Equipment in the Kyrgyz Republic



The following is an excerpt from a report on the results of the financial and economic activity of OJSC "Severelectro" for 2003 and 2004 (an assessment of the company's performance was conducted by PA Consulting Group at the request of the State Energy Agency (SEA)):

"As a result of high losses in the networks, the company saw its revenues reduced. In 2004, the revenues fell by 158.5 million soms as compared to the year of 2003. The volume of electricity consumption by residential customers increased by 30 million kWh and electricity sales revenues by the same customer category fell by 99.8 million soms. If we take into account the fact that tariff increases when electricity consumption grows, then electricity sales revenues should not have gone down. It might happen that not all revenues billed by the group of residential customers have been reflected in the reporting documents. According to the approved tariff rates, residential tariff increases when consumption increases; however, Severelectro witness its fell down by 5.99 tyin/kWh for the residential customers. All those facts demonstrate that metering of electricity consumed by residential customers has not been well organized."

Although Kyrgyzstan's power plants are generating well above the domestic demand of the country, due to the inefficient use of electricity, the country faces serious problems with seasonal power supplies caused by transmission constrains and water-energy related regional

issues. In 2004, the reported gross generation was almost 15 billion kWh with 14 billion generated by the Naryn cascade of the power plants and the balance by thermal power plants.

The failure to improve metering, billing, and collection deprives the network of revenues needed for rehabilitation and modernization. Low tariffs and low collections lead to inefficient consumption. High losses mean that electricity costs go up while reliability goes down. Inefficient consumption increases in the winter and the high winter demand fuels international tensions over the use of water and energy from the Toktogul reservoir, which supplies almost all of Kyrgyzstan's electricity.

The low level of salaries, which are often paid one-month late, offers no incentives to operations and sales personnel to improve performance. This issue, combined with the lack of internal controls and poor management, compels personnel to engage in the illegal sales of electricity and to manipulate records to hide such irregularities creating another main driver for unmetered electricity consumption.

All these problems are essentially due to the weak electricity regulatory regime in the Kyrgyz Republic. The SEA is the only state institution responsible for the reliable and sustainable operations of the sector. Although the Energy Law of the Kyrgyz Republic empowers the SEA with the means to effectively control the sector, the SEA does not take advantage of its powers and yields to political pressures against adopting or enforcing strong measures. The SEA still needs to develop a regulatory framework to become a stronger, more active, and more effective regulatory body that can directly influence the managerial practices of the power sector Licensees, especially in the area of revenue collections.

Overall, a quick review of the power sector of the Kyrgyz Republic shows continued financial and technical deterioration. No noticeable changes in the management practices and regulatory framework have been implemented in the entities of the power sector in order to improve its performance and restore financial sustainability since the creation of the SEA nearly ten years ago.

As part of its assistance to the Government of Kyrgyzstan, the United States Agency for International Development (USAID) through the Central Asia Natural Resources Management Program (NRMP) and the Transboundary Water and Energy Project (TWEP) implemented several electricity loss-reduction demonstration projects. The distribution-level demonstration project consisted of a pilot area within the three joint stock companies (Severelectro, Oshelectro, and Vostokelectro) to address shortcomings in major areas of operations, in particular, internal distribution metering, customer metering, billing and collection of payments (MBC), and managerial practices in revenue collections.

2. GOALS AND OBJECTIVES

The distribution demonstration projects were designed and implemented in order to address the following issues:

- Demonstrate to the SEA and to the management of the distribution companies a correct approach towards loss reduction, which requires an effective and efficient regulatory regime and a strong management method.
- Assess and prove the technical and economic feasibility of the proposed loss reduction technology.
- Train the management and utility personnel in technical specifications and operations of new equipment, such as tamper-proof meters and meter enclosures, and in billing and collection practices.
- Develop recommendations on the replication of the proposed approach across the distribution system of the Kyrgyz Republic.
- Assess the weaknesses and pinpoint the problems in the operations of the distribution companies.

The objective of this report is to analyze the metering, billing, and revenue collection information resulting from the improvements implemented by the three demonstration projects in distribution. The duration of the period of observation varies for the three distribution pilot areas since the project commissioning dates were different. The report shows the results achieved and examines the reasons of any failure of the projects to meet their intended objectives.

3. DESCRIPTION OF THE PILOT PROJECTS AND ANALYSIS METHODOLOGY

A detailed description of the current conditions of distribution networks, the state of metering, billing, and collection (MBC) practices, and the description and justification of the proposed project methodology are available in the TWEP report "Electricity Loss Reduction in the Kyrgyz Republic – Stage I: Identification of Demonstration Projects" dated September 23, 2002. This chapter summarizes the general approach to provide for a better understanding of the analysis methodology and to assist in the interpretation of results.

3.1 Project Methodology

In Kyrgyzstan, distribution companies provide metering at the end-user level to 85% to 90% of their registered customers. The remaining registered customers are billed on the basis of estimated consumption in lieu of meters. There is no internal metering at the high voltage end of all substations. This deficiency prevents tracking of power flows within the network, detecting inconsistencies, and identifying the sources of the losses. End-user metering is inadequate as meters are mainly installed inside the customer premises making them highly vulnerable to tampering. Finally, the MBC software in use does not support internal power balancing even if the information was available from metering. The existing practice does not include any system of internal controls and is not capable of generating reports for identifying problems and enabling management to take corrective actions. Management is essentially "blind" about losses in the distribution system. That was the state of metering and MBC practices at the time of identification of pilot projects. Almost nothing has changed since then except in the pilot areas where metering has improved.

In each distribution company, the loss reduction demonstration projects were designed to implement top-down metering at selected feeders from the distribution transformers to the end-user (Figure 3). The improved metering configuration allowed distribution companies to balance and control power flows at the level of 10/6 kV and 0.4 kV and between each 0.4 kV substation and its corresponding end-users. Thus, each meter in the distribution system would have a master meter at a point upstream in the network against which its readings will be balanced. The installation of end-user meters outside of customer premises enables the utilities to implement sound commercial practices, such as regular meter reading, sample readings, and the associated accurate billing and corresponding disconnection and reconnection of service. The expected final result was an increase in cash collections through reduced fraud and a higher level of customer satisfaction with the quality of installation and customer confidence in the accuracy of metering.

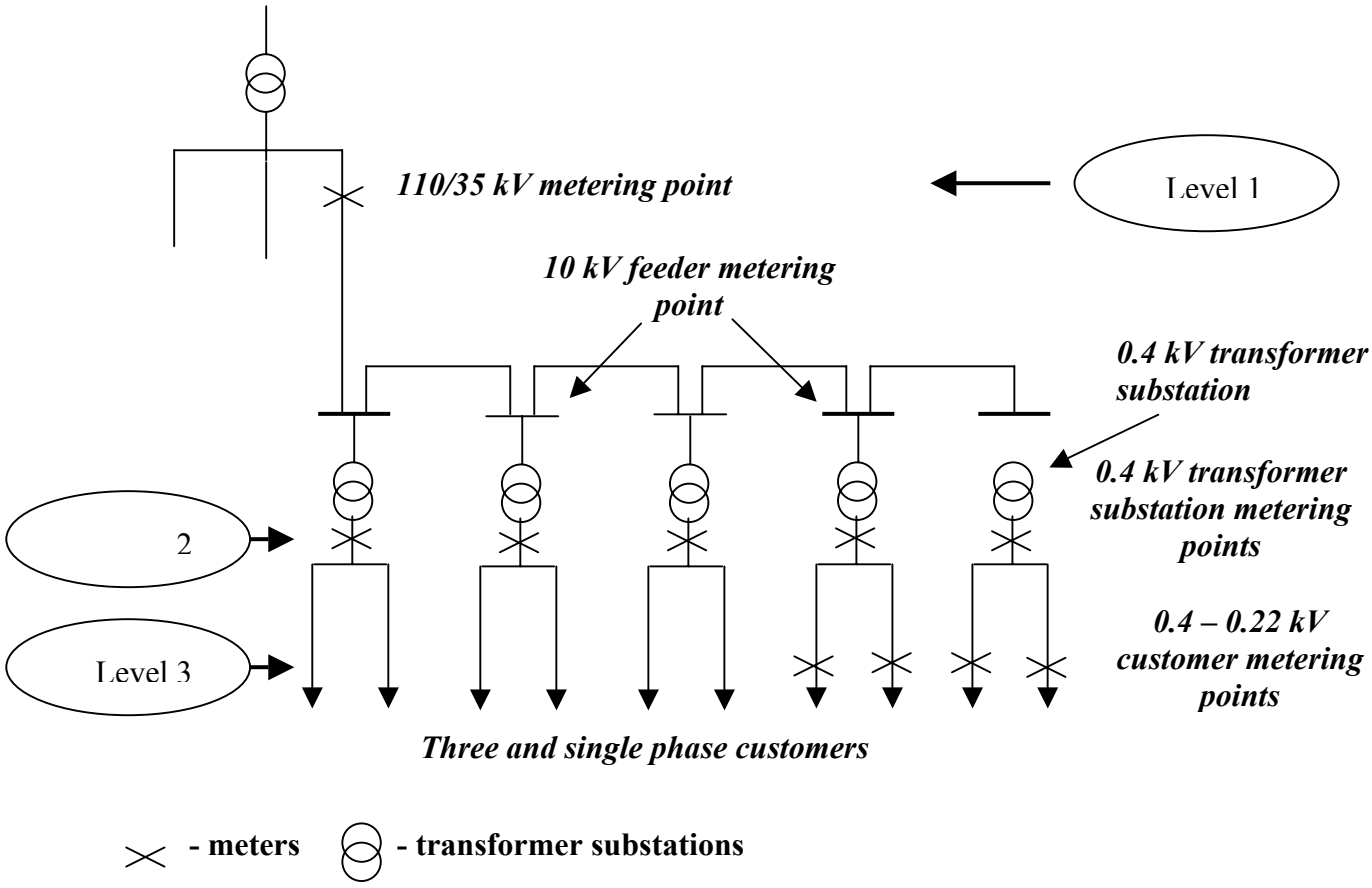
In each distribution company, the project team selected two pilot sites:

- A 10 kV feeder serving several 0.4 kV substations, which in turn feed individual private dwellings. In these sites, electronic tamper-proof meters were installed at the 10 kV inlet and at the 0.4 kV outlets. All meters at the end-users were replaced and located outside of the premises (see Figure 3: levels 1, 2 and 3). In these cases, a three level electricity flow balancing and loss tracking became possible.

- A multiple-dwelling building where a master meter was installed at the inlet point of the building (level 2) and all end-user meters (level 3) were replaced and located in steel boxes outside the customer premises. Balancing became possible between levels 2 and 3. For each multiple-dwelling building in Severelectro and Oshelectro a similar multiple-dwelling building was furnished with a master meter with no re-metering of end-users (referred to as a test area). Since there was no data on losses during the pre-implementation operations and changes in end-use consumption habits were anticipated to be minor, this approach helped to identify changes in MBC operations and also in customer behavior.

In a perfect case scenario, the whole distribution system would be furnished at the nodal points with internal control meters and there would be a system that develops balances and pinpoints the areas with excessive losses.

Figure 3. Schematic Layout of the Metering Approach



At the individual houses, new tamper-resistant electronic meters were installed in locked steel boxes outside of the house but within the customer's premises for easy inspection and meter reader access. The boxes permit easy meter reading through a transparent panel. They are furnished with circuit breakers, which protect the meters from short circuits and simplify the disconnection of non-paying customers.

In the multiple-dwelling apartment buildings new tamper-resistant electronic meters were installed directly outside the front door of each apartment in one of the two apartment buildings in both pilot areas. In addition, a master meter was installed directly outside the fully metered apartment building. In the other apartment building for each pilot area, a master meter was installed outside the apartment building, but the individual meters of each

apartment were not replaced. This approach will enable the distribution companies to compare the performance of master metering with and without complete re-metering of each individual apartment. If master metering of apartment buildings indicate low electricity losses, then the replacement of old individual meters at each apartment could have a lower priority since they are relatively accurate.

3.2 Performance Assessment Methodology

A comparative analysis was used to assess the initial performance of the demonstration projects. With the installation of tamper-resistant electronic meters, comparison of the metered consumption data during the monitoring period with similar data from old meters for the same months of the previous year was performed. In addition, the readings of the various master meters that record bulk supply of electricity at the 10 kV and 0.4 kV network levels were used to estimate the electricity losses during the monitoring period.

All of the data and information was provided by the distribution companies and is detailed in Annexes 1 and 2 of this report. In the case of Severelectro and Vostokelectro, the meters were read at the end of each month and the readings represent the electricity consumption during a full calendar month. In case of Oshelectro the meters were read in the middle of each calendar month. The readings represent electricity consumption during the last half and the first half of two consecutive calendar months respectively.

The following operational indicators are used to compare changes in the pilot areas as a result of the installation of tamper-resistant electronic metering and improved payment enforcement capability:

- Metered consumption of electricity: total for pilot area and per customer;
- Total level of technical losses and unmetered electricity consumption;
- Billing; and,
- Collection of payments.

It is noted that the losses and rates of revenue collection (account receivables) were tracked and analyzed together. These two indicators of performance are interdependent. If management tracks the rate of collection, then financial losses will be buried within high technical losses and the other way around. The same is true for the losses on the feeders at 10 kV and 0.4 kV level.

All analyses were based on data provided by the respective departments of the three distribution companies where distribution demonstration projects were implemented. The data collection and verification became a painful process since submission of data by the companies was always delayed and very often the data provided was meaningless. The project team had to go back and request corrections and verifications of the data.

4. RESULTS OF PERFORMANCE MONITORING

This section provides a multi-dimensional analysis of the results of the loss reduction demonstration projects. The analysis refers to the graphs incorporated in the text and is supported by detailed information provided in Annexes 1 and 2. The period of observation for Vostokelectro was shorter than for other utilities and therefore the analysis of that project is presented in a brief format.

4.1 Metered Consumption and Losses at 0.4 kV Level

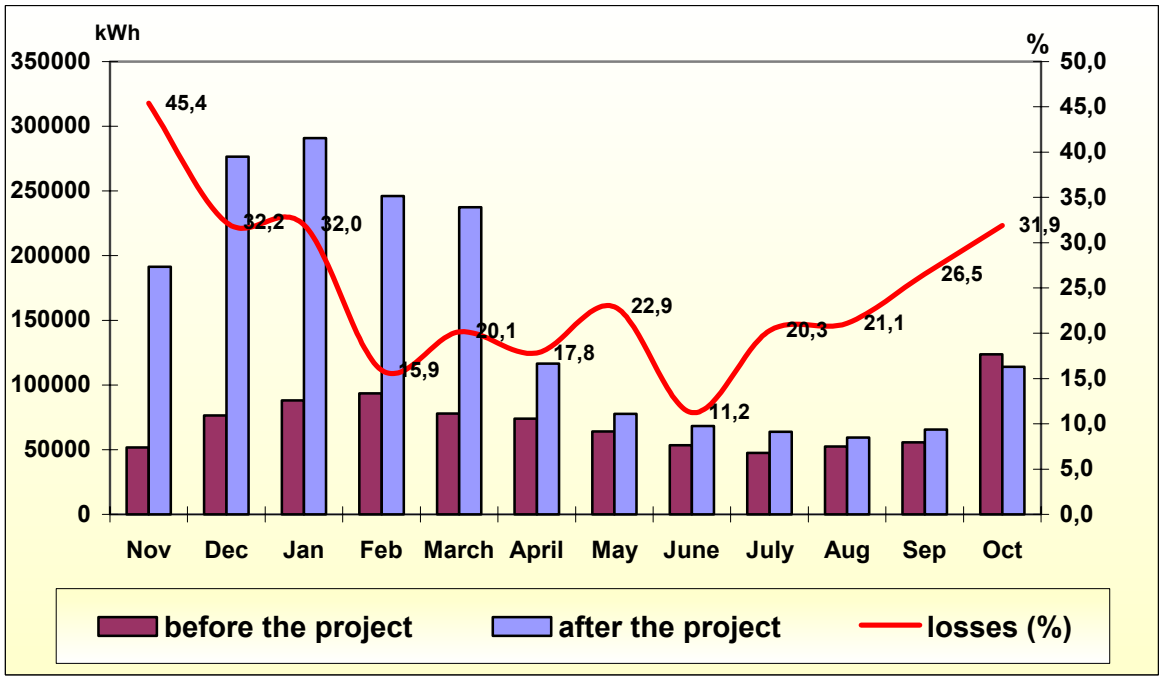
Metered consumption is a key indicator of the performance of the demonstration projects. Since master metering was not available before pilot project implementation, the end-user metered consumption is the parameter that allows a comparison between pre and post implementation performance.

A comparative analysis of total and per-customer metered consumption against electricity input to the measurement area reflects the extent of improvements achieved through the pilot project implementation. End-use consumption is analyzed in conjunction with losses at the 0.4 kV level and their relationship is discussed.

4.1.1 Individual Houses

The changes in total metered consumption by individual houses in the three pilot areas are presented in Figures 4, 5 and 6. Detailed data can be found in Annexes 1 and 2.

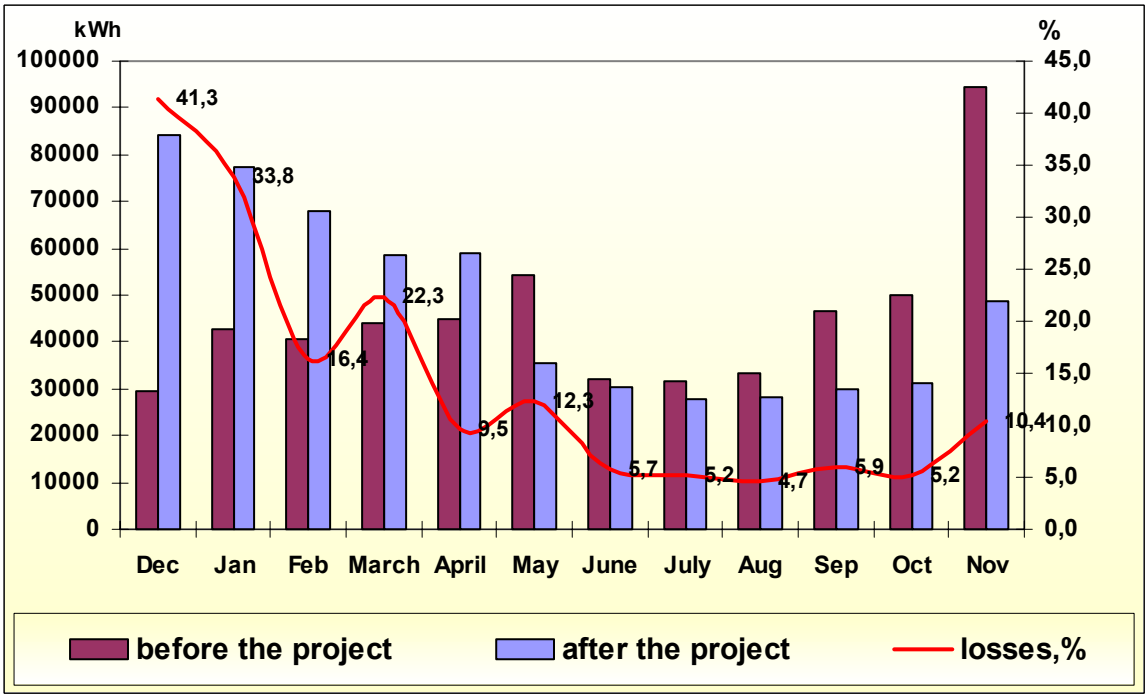
Figure 4. Bishkek Pilot Area: Total Metered Consumption and Losses of Individual Houses Before and After Project Implementation



The data indicates a large increase in metered consumption immediately after project implementation, which occurred during the coldest winter months. After the winter period, metered consumption went down, almost returning to pre-implementation levels. It is apparent that shortly after implementation when the majority of customers were not skilled at how to tamper with new system, the meters registered more kWhs. In any case, the level of losses at the 0.4 kV level shows that a significant amount of consumed electricity was unaccounted. The level of losses was close to the level of acceptable technical losses in June (11.2%) but was back up to 32% the following October. As for the Bishkek feeder, taking into account its load, length, and technical condition, the technical losses are estimated at 6-8 %.

The results for Oshelectro are better than those realized in Severelectro. Again, after the inception of the project, the metered consumption skyrocketed and the subsided as consumers changed their habits to reduce their electricity bills. However, unlike Severelectro, losses in Oshelectro did not return to high levels the following winter.

Figure 5. Osh Pilot Area: Total Metered Consumption and Losses of Individual Houses Before and After Project Implementation



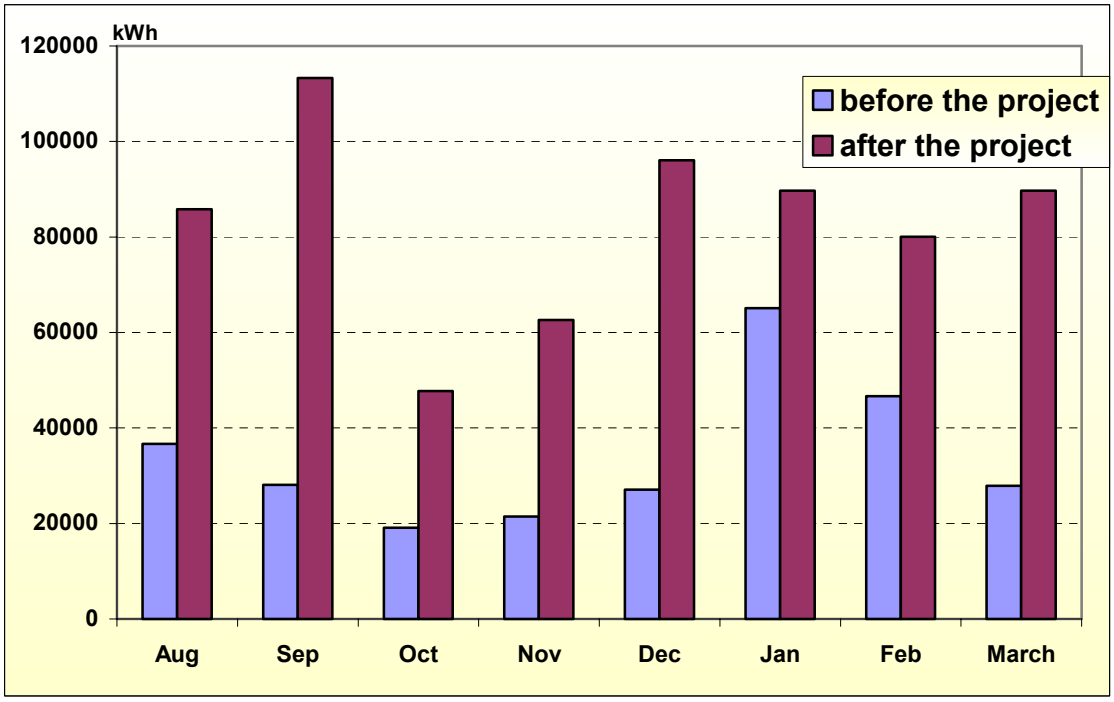
The reasons for the poor performance during the second half of the period of observation will be discussed further in this chapter of this report.

In contrast to Severelectro, the losses at the 0.4 kV level in Oshelectro are more reasonable. As it is seen on Figure 5, after the inception of the pilot project, the losses in the 0.4 kV system went down sharply reaching the level of technical losses of 5% while the metered consumption concurrently increased and, at the end of the observation period, it settled at the operational levels.

The data on single-family dwellings in Vostokelectro showed a significant increase in metered consumption. The overall increase during the eight months of observation brought

end-use metered consumption to a level of 244% above the level in the pre-implementation period. The peaks in demand during August and September are explained by the tourist season in the Lake Issyk-Kul region and by higher electricity demand for heating during winter months. Figure 6 below depicts results of Vosokelectro pilot project.

Figure 6. Cholpon-Ata Pilot Area: Total Metered Consumption of Individual Houses Before and After Project Implementation

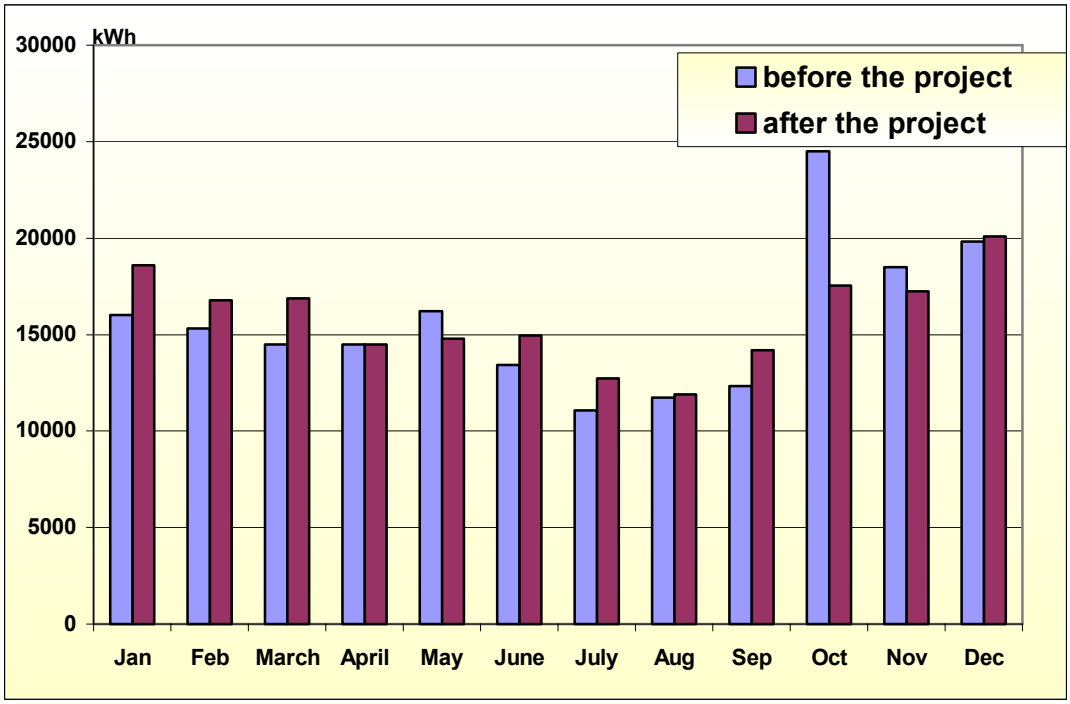


Despite poor management and weak regulatory oversight, the per customer consumption has changed due to the improved metering infrastructure. During the observation period, metered consumption increased by 200% in Severelectro pilot area, 106% in Oshelectro, and 244% in Vostokelectro. Annual results are modest compared with those received during the initial six months due to the higher theft and changes in customer behavior. During the first six months of performance, the per customer average monthly-metered electricity consumption increased from 350 kilowatt hours (kWh) to 900 kWh (an increase of 257%) in Bishkek (Severelectro service area) and from 260 kWh to 465 kWh (an increase in 179%) in Osh (Oshelectro service area).

4.1.2 Apartment Buildings

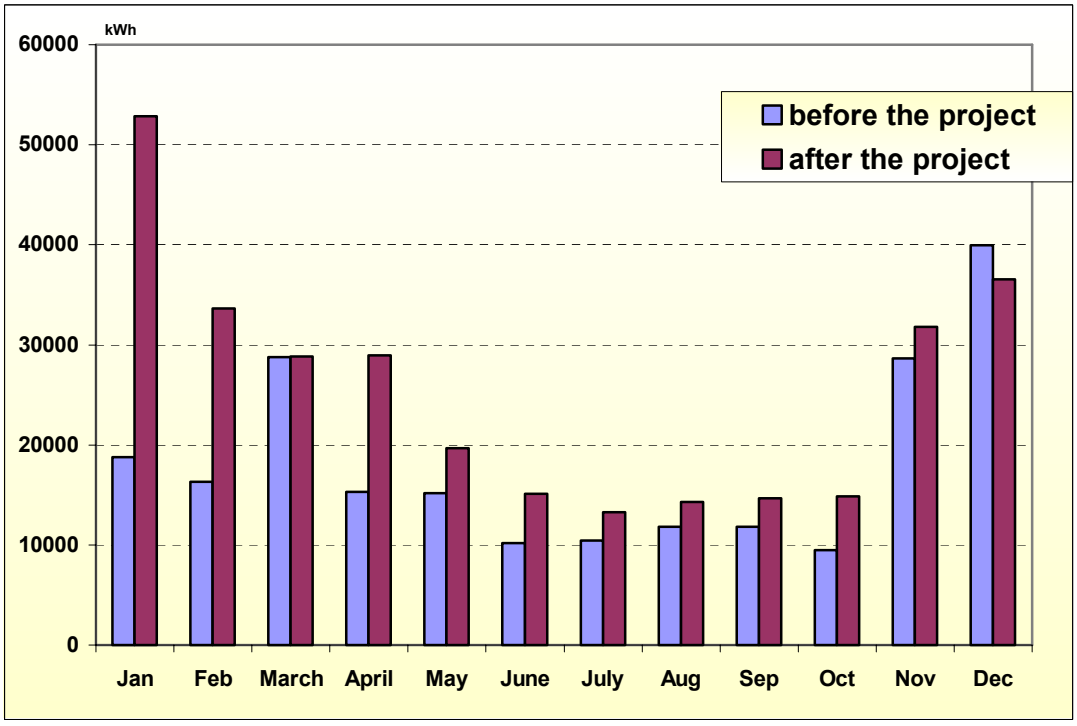
The changes in total metered consumption by apartment buildings in the three pilot areas are presented in Annex 3 and 4 and summarized in Figures 7, 8 and 9. The annual increases in metered electricity consumption in Bishkek pilot area were inconspicuous (only 1%) and considerably less than the recorded increases in electricity consumption by individual houses.

Figure 7. Bishkek Pilot Area: Total Metered Consumption in Apartment Building Before and After Project Implementation



The Osh multiple-dwelling building pilot demonstrated an increase in metered consumption due to the pilot project implementation. In relative numbers it increased by 40% and in absolute numbers by 90,000 kWh.

Figure 8. Osh Area: Total Metered Consumption in Apartment Building Before and After Project Implementation



A possible explanation for the smaller increases in metered electricity consumption (or reduction of theft) in apartment buildings as compared with individual houses is that the apartment buildings are connected to the district heating system. Thus, the electricity demand by apartments in winter is much less than the demand by individual houses, reducing the incentives for unmetered consumption. Another reason might be that unmetered electricity consumption by customers in apartment buildings is more visible to neighbors, thus further reducing the incentives for theft.

Quite significant results were recorded in the multiple-dwelling building in Vostokelectro (see Figure 9 below).

Figure 9. Cholpon-Ata Pilot Area: Total Metered Consumption in Apartment Building Before and After Project Implementation

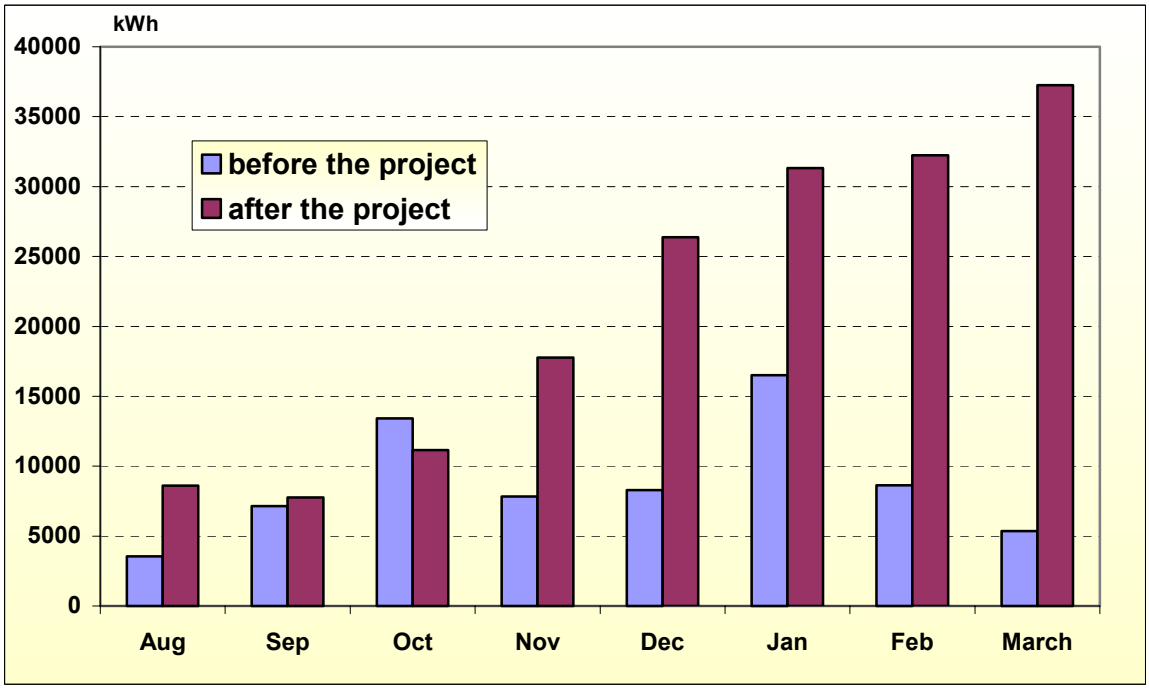


Figure 9 demonstrates that in the heating season, the multiple-dwelling building in Vostokelectro was consuming significant volumes of unaccounted electricity. Metered consumption increased noticeably and reached 244% of its pre-implementation volumes. The explanation for this is that district heating is not available to the building and customers rely heavily on electricity. The improved metering infrastructure prevented tampering with meters by customers and/or meter readers thus preventing unmetered consumption.

As it was described above, another approach used in the pilot project was to compare losses in a pilot and test multiple-dwelling buildings in Bishkek and Osh pilot project areas. The test pilot in Vostokelectro was not conducted due to time constraints. Along with the comparison of pre and after implementation, metered consumption in the pilot area, the assessment of the pilot and test multiple-dwelling building's metered consumption will provide another indicator of achieved results, provided in Figures 10 and 11 below.

Figure 10. Bishkek Pilot Area: Losses in Apartment Buildings with Meter Replacement and Master Meter Only

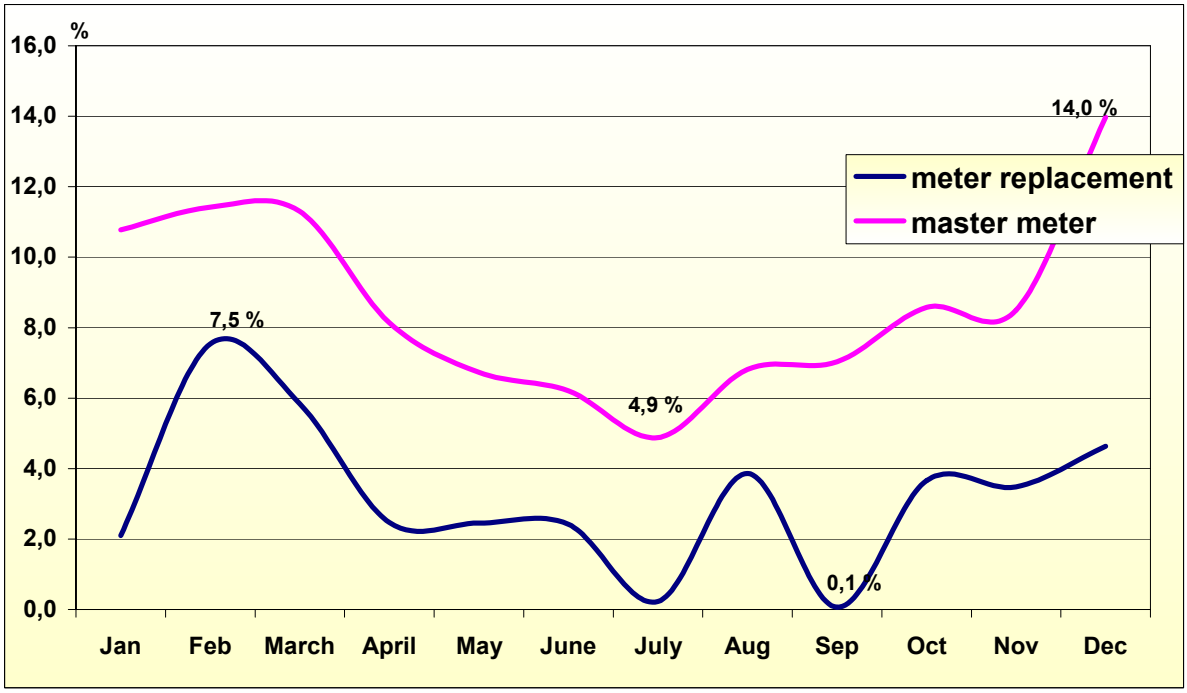
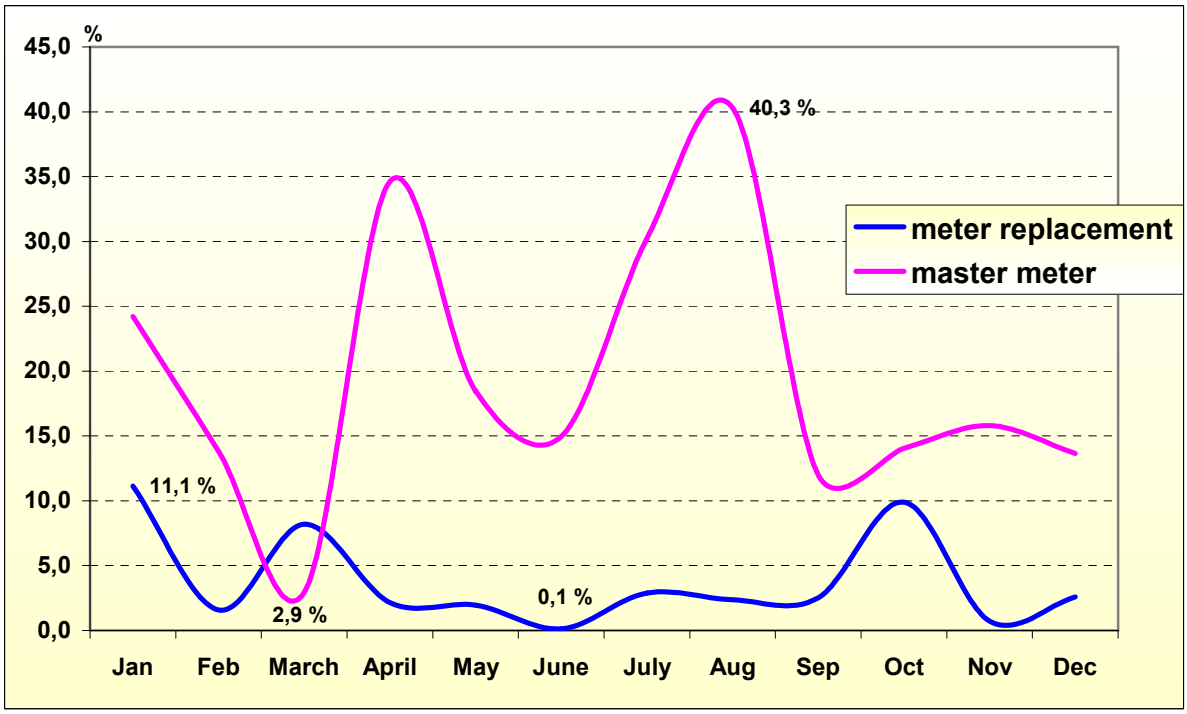


Figure 11. Osh Pilot Area: Losses in Apartment Buildings with Meter Replacement and Master Meter Only



As shown above, there are slight differences in the losses in the pilot buildings compared to the test buildings. In the Bishkek pilot project, the annual electricity losses in the pilot building were 3.4% in comparison with 9% in the test building. In Osh area, that difference

was significantly higher; in the pilot building it was at the level of 4,6%, while in the test building it was five times higher. This phenomenon suggests monitoring losses in the multiple-dwelling buildings with master metering would reveal the areas with high losses and justify necessary investments and actions.

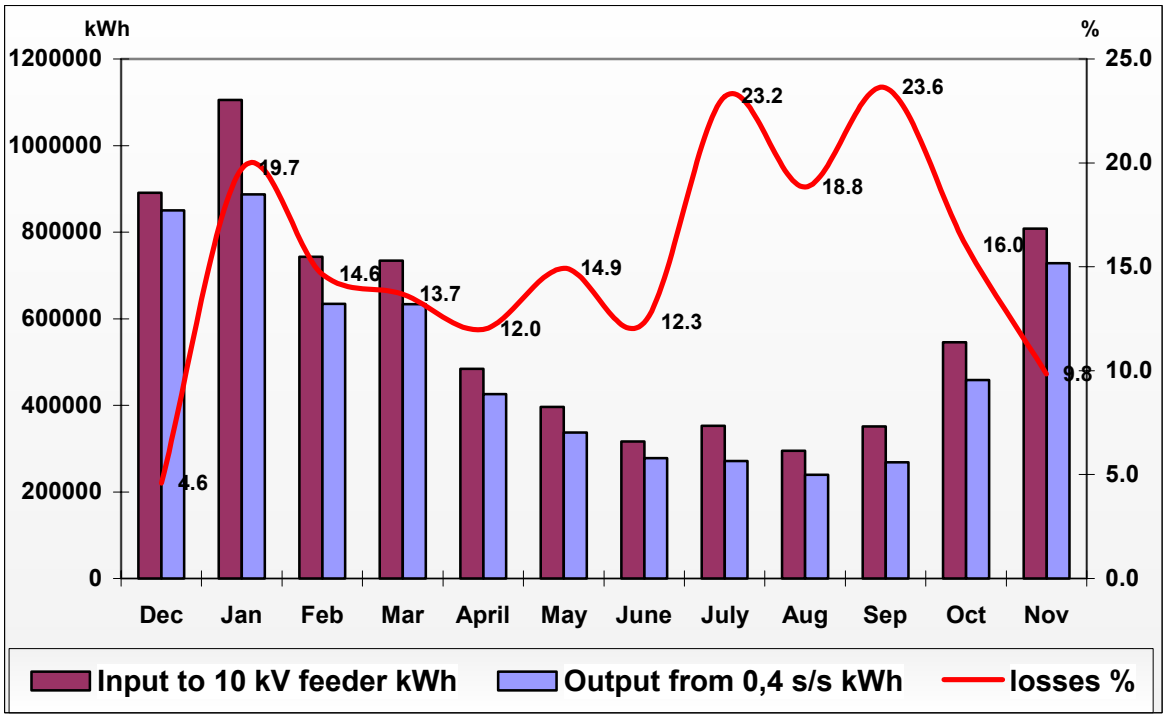
According to this data, the potential for electricity loss reduction in the apartment buildings in Vostokelctro and Osh is larger than in the apartment buildings in Bishkek. Another possible reason for the smaller increase in metered electricity consumption in apartment buildings in Bishkek was that while the district heating system in Osh is less reliable, in Vostokelectro it is not available at all.

4.1.3 Electricity Losses in 10 kV Feeders

The distribution networks of Kyrgyzstan are lacking internal metering infrastructure, thus it is impossible to meter the difference between delivery and consumption to track distribution losses. As part of the implemented pilot projects, the internal metering on 10 kV feeders was designed and implemented.

In the Bishkek area, the balance of the 10 kV feeder has accepted shape following seasonal demand patterns. However, the recorded losses remained very high during the whole observation period. The technically acceptable losses for this type of 10 kV lines (length, load, type of wires) lie within the limits of 2 to 3%. Figure 12 depicts losses as high as 23%.

Figure 12. Bishkek Pilot Area: Balance of 10 kV



In the Osh area, the level of losses on the 10 kV feeder were more modest and closer to the technically acceptable levels. Except for peaking in March to the level of 10%, the losses were fluctuating below the ceiling of 5%. The overall picture would be good if the shape of loads on the feeder did not raise some questions. The feeder feeds the private neighborhood

where district heating is not available. In November, the weather in the Osh region required the premises to be heated and electricity is one of the fuels used for heating. However, the reported balance of the feeder did not follow seasonal patterns and it might be due to the data manipulation by the staff of Oshelectro.

Figure 13. Osh Pilot Area: Balance of 10 kV

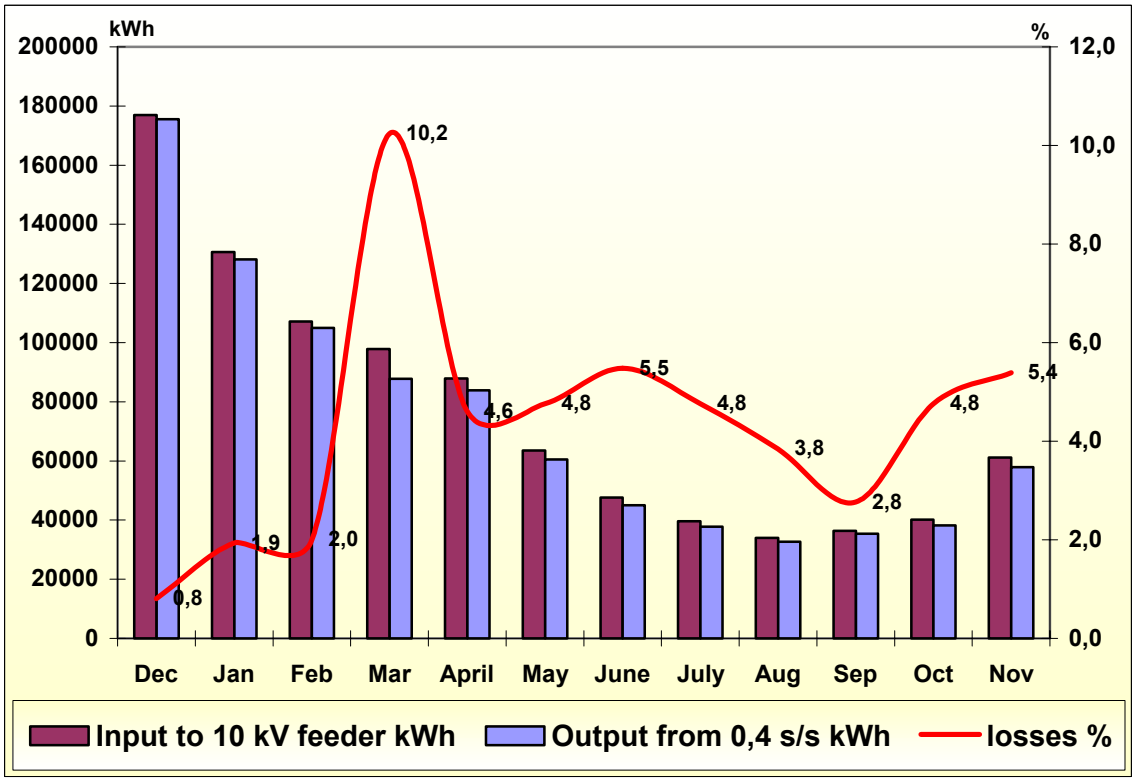
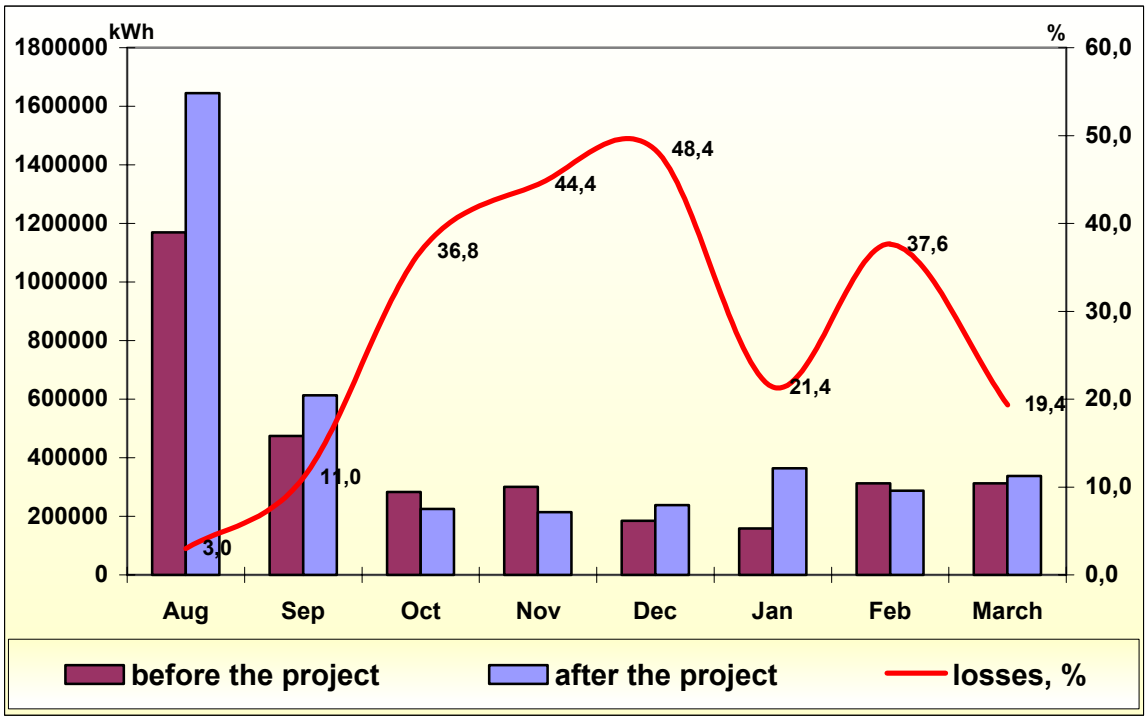


Figure 14 shows the performance of the 10 kV feeder in Vostokelectro, which is constructed differently than the Figures for the two previous projects. That feeder is not feeding 0.4 kV substations which then feed end users. All substations connected to the feeder are located in resorts around the Lake Issyk-Kul. That is why Figure 14 was designed to reflect metered consumption by resorts before and after the pilot project implementation and accompanied by the curve depicting the total losses on the feeder. Although the losses on 10 kV feeder were high, the overall picture is logical. Immediately after the commencement of the project, the losses recorded in the technically acceptable limits (the first month always surprises both the customers and meter readers who do not yet know how to tamper with the new equipment), then the losses rocketed to the high forties level and the metered consumption by the resorts returned to the levels recorded before the installation of the new meters.

Figure 14. Vostokelectro Pilot Area: Balance of 10 kV



There were several sources for the losses in 10 kV system and some of them were observed during the course of pilot project implementation and monitoring:

- Distribution companies do not always control and know the actual configuration of the electric system. In the Severelectro pilot project area, after several months of searching, the operation personnel found a 10/0.4 kV substation connected to the pilot feeder. There is no guarantee that there are no other substations, which personnel cannot find.
- In the Osh pilot area, a big customer connected itself to the 0.4 kV bus bar before the meter and protective devices, thus consuming the electricity unmetered and contributing to the losses on the 10 kV system. It took several months for the management of Oshelectro to disconnect the unmetered customer.
- In the Vostokelectro area, several resorts did not allow the personnel of the distribution company to enter the substation and read the meter. Customers themselves decided how much they consumed and reported to the utility. These customers are called “untouchables” since they belong to or are protected by the high level politicians.

- Some of the losses might have been caused by malfunctioning or improperly connected metering equipment. The management of distribution companies had no interest in sending a crew to test the metering equipment.
- Even though implementation of the pilot projects provided significant improvements in end-user metering and billing, the level of losses, especially in the resort area, remains unacceptably high. The excessive losses in the 10 kV networks are the same unmetered consumption and unbilled electricity, which contribute significantly to the total losses of distribution networks.

4.1.4 Billing and Revenue Collection

Improvement of the metering infrastructure with increased end-use metering is anticipated to improve the actual level of billing and collection of revenues in pilot project areas. This sub-section assesses the extent of improvements achieved in billing and collections. New metering and disconnection infrastructure should ease operation personnel's efforts to enforce disconnections for non-payments. Improved capacity of distribution companies to collect bills should be reflected on the level and age of accounts receivable on the accounting records.

Assessment of the level of billings as opposed to increased metered consumption is required because of the complex structure of the tariffs in the power sector of Kyrgyzstan. The lifeline tariff below 150 kWh creates a highly nonlinear relationship between billings and metered consumption. Consumption up to 150 kWh is billed at 43 tiyin per kWh and consumption above that is billed at 80 tiyin/kWh. There are two major causes why we anticipate higher increases in the billings as compared to metered consumption:

- Fraudulent users usually have relatively high levels of consumption that would be billed at the 80 tiyin/kWh level.
- It has been our experience elsewhere that the presence of a lifeline tariff reduces billings due to fraud in reporting customer lists. The more customers reported to consume under the lifeline level of 150 kWh per month, the better the performance of the distribution company is perceived. To reduce the actual bills while not increasing the electricity losses, distribution companies were adding non-existing customers to the list and recording 150 kWh of the monthly consumption to all customers.

In addition, utilities are assigning huge consumption to quasi-budgetary consumers such as water pumps, city electric transport, etc. Since the collection of revenue from such customers is not a responsibility of the distribution company (usually it is off-set by the budget or written off), this does not create any real liability neither for a utility or for the customer.

Analysis of the billing in Bishkek and Osh pilot areas had different results. The billing in Bishkek increased over metering by 10-30% only, while in Osh area it increased by 260%. This issue can only be investigated and resolved by proper internal control mechanisms deployed at the accounting and reporting level of the utilities.

Regardless of deficiencies in the operation of distribution companies, the collection rate was substantially affected by the pilot project implementation. Thus, the collection rate in individual house pilot project area in Bishkek increased threefold and 2.4 times in Osh. Figures 15 and 16 represent the increase in collections per customer in individual house pilot project areas in Bishkek and Osh.

Figure 15. Bishkek Pilot Area: Collections per Customer in Individual Houses

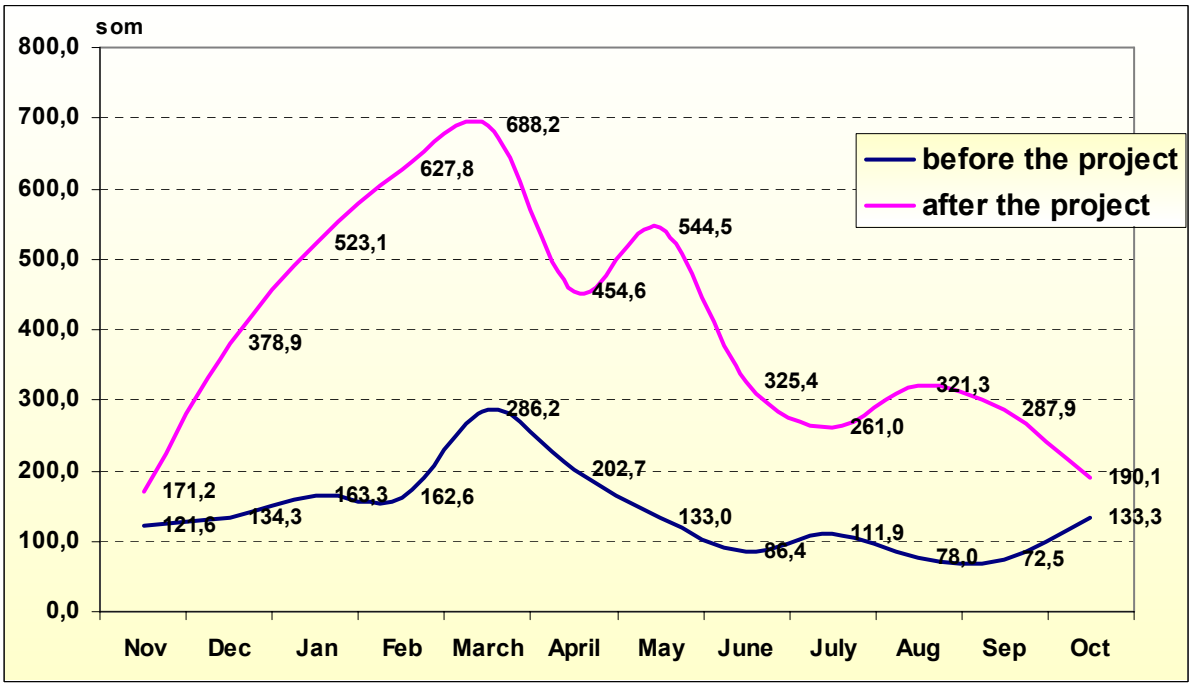
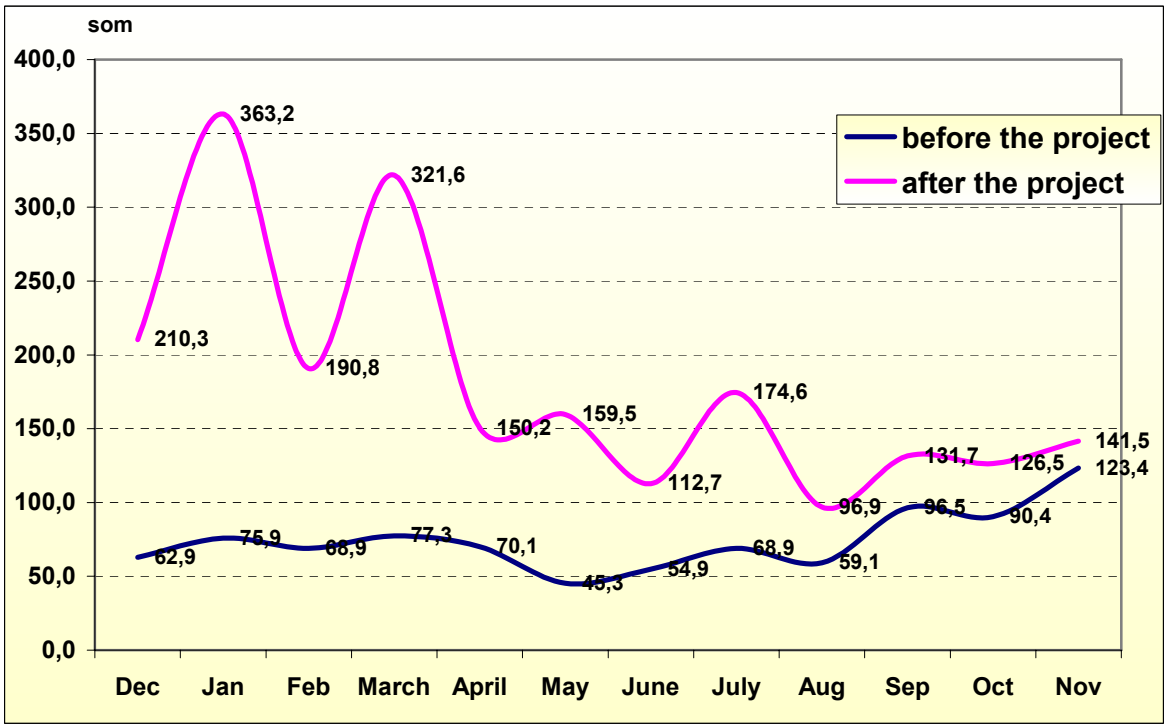


Figure 16. Osh Pilot Area: Collections per Customer in Individual Houses



As it is seen from these figures, collections per customer have increased significantly immediately after the commencement of the projects and then gradually returned nearly to the original levels. The improved collection rate is primary the result of the improved capacity (and willingness) of utilities to enforce payments. Meters placed outside customer

premises with circuit-breakers in the boxes played a significant role since the personnel of the utilities were following operational instructions from the beginning of the project. Beyond the initial period, customer collection follows the same deteriorating pattern discussed in previous chapters.

5. ECONOMIC ASSESMENT OF THE DEMONSTRATION PROJECTS

Economic assessment of the two pilot areas in Severelectro and Oshelectro was undertaken to justify further investments in modern metering systems. For this reason, two major indicators were used as criteria to make an investment decision:

- Simple payback period - this indicator is used when the capital investment is small or when the merits of the project are so obvious that a more formal analysis is unnecessary.
- Internal Rate of Return (IRR) – this indicator is used to compare the benefits of the project with the opportunity cost of capital.

The period of ten years was selected for the analysis taking into account the life service of the electrical equipment. As for the cash flow during this period, the additionally generated revenue (AGR) from the pilot area was selected and represented the difference in collections before and after the project implementation. For the calculations this difference in revenue generated by the projects was adopted at a level of actual billings that assumed a 100 % collection rate.

For the remaining nine years, this actual figure was then correlated to the different assumptions on the collection rate starting from 90 % at the second year and increasing to the end of analysis to 95 % (Annexes 5 and 6). Due to the increased attention to the pilot areas during the monitoring periods by the distribution companies, we achieved a high collection rate. Eventually, it was expected that the collections would stay within 90 to 95 %.

The value of the old replaced equipment was considered although it could improve the economic feasibility of the project. Old replaced meters were transferred to the distribution companies with the request to implement the same metering approach in other areas where meters are missing.

Investment in the project included meters, wires, cables, and installation work contracted by the NRMP to local electrical contractors operating under the supervision of the utility for code compliance.

Severelectro Service Area

For the Bishkek pilot area serving individual houses, using a total investment of $43,800 USD, the simple payback period was determined to be 2.1 years and the IRR of the project was determined to be 44 %. This is substantially higher than the credit interest rates of the commercial banks. Under financing of the IFIs, these projects become even more attractive. Individual consumer meter replacement at multiple-unit buildings in Bishkek did not significantly increase the level of collections, and therefore offered a less attractive financial performance. These buildings should be monitored using master meters to establish the urgency to make investments in the replacement of meters of individual customers.

Oshelectro Service Area

Investment in the Osh pilot area with individual houses was $27,000 USD. Under the current collection rate equal to 80%, the simple payback period and IRR of the project was 5.7 years and 10 % respectively. However, if a 100% collection rate be achieved through management improvements, then the same indicators would yield 4.1 years of payback and an IRR of 19 % which is financially attractive as a commercial operation, more so with soft financing. The multiple-unit building in Osh generated a payback period of 13.5 years, offering similar results as in Bishkek. Nevertheless, monitoring of the apartment building in Osh ensured substantial growth of metered consumption and reduction of losses (see section 4.1.2).

Based on this data, it appears that investments in metering for individual houses are commercially attractive even under the existing high level of annual electricity losses ranging from 21.1 % in Osh to 28 % in Bishkek in the 0.4 kV networks further aggravated by the low collection rates. In fact, more aggressive enforcement and compliance of the distribution companies would make these projects even more attractive.

6. METERING, BILLING, AND COLLECTION SYSTEM AND MANAGEMENT PROCEDURES AND PRACTICES

The assessment of the Distribution Demonstration Projects revealed multiple weaknesses in management practices, procedures and utilized metering, billing, and collection (MBC) systems. The existing approach does not and cannot provide the necessary conditions to reduce the losses. Overall, there was very little interest in loss reduction activities on management's part in general and in our pilot projects in particular. There are several major issues, which should be addressed before any progress can be ensured. Some of the issues were discussed in the NRMP report "Identification of Demonstration Projects" dated September 23, 2002. Very little has changed since then.

High voltage metering in distribution networks is only carried out at the delivery points, where distribution companies receive power from the transmission grid. The next level of downstream metering is at the end-users. There are no meters at intermediate points such as the terminals and feeders of 10/6 kV or at the incoming feeders of substations at 0.4 kV. This deficiency precludes tracking of power flows within the distribution system, which would help identify the source of losses and verify meter accuracy. Due to insufficient end-use metering, consumption figures for approximately 10% to 15% of the customers are estimated by the meter reader/controller based on the number of outlets and/or electrical appliances installed with obvious vulnerability to corruption.

Many of the meters are well beyond their service life, while others have suffered from inadequate maintenance. All existing meters are of an outdated design and do not have the necessary functionality of modern electronic meters to measure and record the amount of received energy. Approximately 70% of end-user meters were built in the 1960s and some even earlier.

Many apartments, commercial enterprises and single-family homes throughout the service territory of the distribution companies have inadequate and improper electrical installations including both primary and secondary wiring and meters. In addition to the serious threat to safety resulting from exposed wiring and unauthorized connections that use improper wiring, the following abuses are widespread:

- By-passing of electrical meters from the supply wires in the private houses and cables generally located in the basements of multiple-dwelling buildings; and,
- Tampering of unsecured meters that use old-fashioned seals with no control capabilities.

Although some meters in multi-family buildings have been moved outside and sealed into metal boxes, the quality of the installation is not satisfactory and there is a risk that trained electrical contractors could tamper them.

New customers are not always properly recorded and reported. This includes both residential and commercial customers. In the Severelectro area many commercial establishments were consuming unmetered electricity and despite NRMP/TWEP reports to utility management, these irregularities were not corrected.

The system lacks internal control mechanisms. There is no system of accountability for the level of losses and revenue collections in any specific part of the distribution company. There

is a nominal incentive for inspectors in Severelectro, - a portion of the customer penalty is paid to an inspector when he reveals and documents an unauthorized connection. However, while inspectors recorded many cases of theft, the stated incentive bonuses were never paid to them.

MBC software used in the distribution sector is outdated and does not meet basic requirements of commercial operations. The system does not allow tracking of network operations and thus precludes a consolidated database of operational and commercial data. This deficiency results in fragmented information that does not offer a consistent and verifiable picture of the operation of the distribution system. The MBC software is not protected from unauthorized entry and it is open to intrusion by anyone with a basic knowledge of the system who could alter consumption data, financial information, or even add or remove customer accounts.

Overall, the management of the power distribution sub-sector does not have a credible loss reduction strategy nor an action plan, which would provide for personnel and resources in order to implement it. It is noteworthy, however, that project staff met people who have good ideas and knowledge on how to resolve the problem, but they cannot act without the full commitment of utility management at a higher level.

7. THE ROLE OF THE STATE ENERGY AGENCY IN ELECTRICITY LOSS REDUCTION

The recommendations of this chapter mirror the previous report developed under Task 5 of the NRMP to assist the State Energy Agency (SEA) of the Kyrgyz Republic in strengthening regulatory reforms and markets in the gas and electric power sectors, which included recommendations for the SEA on its role in loss reduction in the power sector of the Kyrgyz Republic.

The existing situation in the energy sector reflects the weaknesses and inability of the SEA to perform its stated role of monitoring performance of the sector. If the SEA is to become effective in its oversight, it must strictly track efforts by the distribution companies and enforce that these efforts meet stringent specifications. As the final analysis showed, the distribution company managerial problems are of a regulatory nature. To address the problem, there must first be a clear procedure for measurement of the problems to monitor progress in their solutions. The failure to improve metering, billing, and collection results in the system being deprived of its revenues critically needed for rehabilitation and investment. Eventually tariff increases will be required to recover from the current technical and financial conditions. The high losses will cause electricity costs to go up while reliability will go down.

The reduction of electricity losses requires a strong regulatory agency willing and able to use all the regulatory tools available under its authority. It needs to obtain compliance with the license requirements by the distribution companies who must collect the revenues that support the entire electricity sector. Under circumstances when the political leadership of the country is not willing and the management of electric utilities is not interested in dealing with the continuing deterioration of the sector, the SEA should become a more active and aggressive regulatory agency capable of using the authority it has to reduce the persistent and excessively high electricity losses that are threatening the energy security of the Kyrgyz Republic.

According to the Cooperation Agreement between the NRMP and the SEA, the parties agreed to develop an Electricity Loss Reduction Program. As a result of the activities performed under the Cooperation Agreement, the SEA Executive Council approved Resolution 148-17 on “Approving the Program of Electricity Loss Reduction in the Distribution Lines” on August 30, 2004. The Resolution established loss reduction-related reporting requirements for distribution companies. The reports on identification and enforcement to reduce theft and non-payment and the filing of comprehensive loss reduction plans were included in the requirements.

According to the specific requirements the information in the filed comprehensive plans should include:

1. Internal structure and operational practices for control and monitoring of electricity loss reduction, including the specific routine for load flow monitoring and identification of who is responsible within the company for different loss reduction functions; and,

2. Electricity loss reduction investments, including the anticipated source of funds, priority level, and the expected outcomes.

The performance requirement recommendations include requirements and penalties for:

1) Service Quality Indices;

2) Infrastructure Requirements; and,

3) Operational Requirements.

The instructions for the comprehensive electricity loss reduction plans and the performance requirements are critical integral elements of regulatory oversight of the distribution companies. They incorporate the findings and recommendations of the TWEP report and are designed for integration with the already adopted reporting requirements. In addition, the comprehensive loss reduction plan and recommended instructions provide the basis for anticipated public hearings in the territory of each distribution company on electricity loss reduction and improved service. The combination of the reporting requirements and the recommended instructions and performance requirements target deficiencies in distribution company management and provide rules and regulations to increase the level of enforcement by the SEA.

In fact, the ability of the SEA to enforce compliance with license obligations is limited by political interference in tariff setting and government ownership of the Joint Stock Companies that have the licenses. Nevertheless, the SEA does have enforcement authority it can use and it can enhance that authority through the type of rules and regulations it adopts. SEA has only two realistic methods of enforcement left:

- The Administrative Code of the Kyrgyz Republic, Chapter 32. Administrative Infringements of Energy Use.
- Public disclosure of information on company performance and public outreach to increase awareness of electricity sector issues.

The SEA can and must use disclosure of the information on performance as a method to influence company behavior. This can be done in several ways:

- Inform government officials and parliament and propose corrective actions;
- Inform the Boards of Directors and General Meetings of Shareholders of the companies and suggest corrective actions, including replacement of company officials and managers; and,
- Inform the general public and involve them in the strategy for reduction of losses and service quality improvements through public hearings and other means.

It is the SEA's responsibility to increase public awareness of the problems and to involve the public in the process of solving those problems. Public understanding and support for loss reduction is a vehicle for creating the necessary political will for needed changes in the management of the electricity sector.

The SEA, with assistance from NRMP/TWEP, has developed reporting forms and requested detailed plans to reduce electricity losses from the distribution companies. The essence of the

reporting forms has been agreed upon by all four distribution companies to ease the burden of reporting requirements. In addition, distribution companies are now working on plans that include investments on master meter installation and anticipated sources of funding. After that, both the reporting forms and complex plans will be approved by resolution of the Executive Council of the SEA. Unfortunately, the distribution companies have missed the deadline for submission of their loss reduction reports with little reaction from the SEA.

8. LESSONS LEARNED AND RECOMMENDATIONS

During the project implementation and monitoring phases, the project team faced multiple issues and difficulties, which diminished the expected outcomes of the project. The main issues are discussed in this chapter followed by specific recommendations.

The management of all three distribution companies demonstrated very little interest in the success of the distribution demonstration projects. The management of Severelectro was very indifferent towards the projects even to the extent of creating obstacles for the project implementation. Since the utilities are still in the hands of the state, the lack of cooperation on the part of the distribution companies can only be attributed to the lack of political will at higher government levels for resolving the situation with losses and low revenue collections in the power sector. The issue is aggravated by the weak and inactive State Energy Agency, which is the only state institution responsible for the sustainable operations of the sector. Clearly the projects demonstrated that the problem does not lie in the lack of capital. The results showed that further injection of capital would not allow retention of any benefits derived from the projects, unless the utilities are determined to adopt proper managerial practices.

Data collection and reporting was very difficult and time consuming. The TWEP team had to go back many times to request, verify, and clarify information, which quite often was meaningless. During two months, personnel of Severelectro reported that they were “busy with elections” instead of performing their specific duties. No information was provided during the period of elections.

In no instance did the management of the companies request information on our projects or enquire about progress nor assess or question its operations.

Discipline and integrity are clearly scarce commodities within the distribution companies. Fraud and meter tampering are common amongst the employees of the companies and openly tolerated by management. In the Severelectro pilot project area, an employee of the company made an unauthorized cable connection around the meter. After many reports to the management the cable was removed only after the winter was over with no punishment to employee.

The level of losses in pilot project areas did not draw attention from the management of the companies. No real action was undertaken by the companies’ managements to investigate and reveal the source of the losses, to learn lessons, and use the gained experience in other parts of the sector. “Business as usual” is the attitude which exists in the distribution companies.

“Untouchable” customers, with high level connections at or above the distribution company level exist in all distribution companies servicing residential customers, as well as saunas, resorts, restaurants, etc. In the Vostokelectro pilot area, big resorts pay what they wish and distribution companies have no power to interfere.

Although Severelectro is repeatedly mentioned in this report, the issues are common to all distribution companies. Only the proximity to the project headquarters made the problems more visible in Severelectro than in other companies.

The directive from the political leadership has to be changed before things get better in distribution sector.

There are many other “minor” issues which affect operations of the sector and some of them are discussed below:

- The current rate schedule is unnecessarily complicated with 11 categories of customers, mostly based on type of activity and most of which have a two-part (peak demand and energy) tariff. Such a "scientific" approach to the rate schedule is difficult and costly to implement in practice, and it creates the basis for collusion between customers and utility. The rate schedule has to be simplified and reflect the real cost of service to each group of the customers. Direct and hidden subsidies through electricity rates should be removed and subsidies provided through the National Social Protection Plan funded from the central budget.
- One of the examples of collusion due to the complicated rate schedule is as follows. Initial analysis of the metered electricity consumption by individual house customers may indicate an important operational deficiency of the distribution companies. Many individual house customers use three-phase meters and consume more than 4,320 kWh/month (6 kW x 30 days x 24 hours), but they are not registered as a “customer with installed capacity above 6 kW”. This means that these customers are not billed a capacity charge in addition to the electricity consumed. Although the installed meters allow for recording the maximum demand, neither Severelectro nor Oshelectro have used this feature to justify a higher tariff schedule for these customers.
- The role of the Energy Inspectorate is not clear and many controversial instructions are not helping to reduce theft from the sector. The role of this agency should be clarified.
- The initial data and information suggests that individual houses offer a greater potential for reduction of residential electricity losses. Thus, individual customer, tamper-resistant electronic meters should first be installed at individual houses. Apartment buildings should be monitored using master meters to establish the urgency to replace individual meters of individual customers. Moreover, stronger efforts to track distribution electricity losses should be emphasized during the winter months when the incentive for theft is greater.
- Although the pilot projects demonstrated some positive results, the overall performance cannot be treated as satisfactory. A massive investment will not be effective unless the political will is demonstrated and the regulatory framework is developed.

The following constitutes a simple action plan, which is recommended for implementation if a loss reduction strategy is accepted at the highest political level:

- Implementation of the nodal internal metering, which would enable distribution companies to perform internal power flow controls and loss tracking;
- Development of MBC software that would have the capacity to track internal power flows and generate management reports. All customers should be consolidated in one database to perform distribution loss control reports.

- Internally, companies should make their authorized personnel responsible for losses in certain segments of the network. In the networks of 35/10/6 kV, the responsibility should be given to the technical department and in the networks of 0.4 kV to the sales.
- Companies should perform baseline loss assessment for all segments of the networks and develop loss reduction targets with incentives and penalties for the authorized personnel.
- Payment of electricity bills should be done only through the banking system. Meter readers should not accept any cash from the customers.
- These measures should be performed in coordination with the reporting requirements, established by the SEA. The SEA should approve and oversee the proposed detailed action plans.

ANNEX 1. JSC SEVERELECTRO: MAJOR INDICATORS OF INDIVIDUAL HOUSES BEFORE AND AFTER THE PROJECT

Bishkek Pilot Area: Substation # 1441

Year	Indicator	Units	Nov	Dec	Jan	Feb	March	April	May	June	July	Aug	Sep	Oct	Total
before the project	Metered consumption	kWh	24979	37324	41225	46087	39405	35401	32788	27602	25416	30780	30516	62958	**434481**
	Billing	som	14277,0	24189,5	27595,1	31069,1	26406,0	22754,2	19962,4	16177,0	15092,3	18672,3	18255,1	44962,3	**279412,4**
	Collection	som	10536,7	14749,5	19710,5	18479,9	21984,1	20889,2	14418,2	9880,4	11327,8	9023,1	8759,5	20982,8	**180741,6**
	Collection rate	%	73,8	61,0	71,4	59,5	83,3	91,8	72,2	61,1	75,1	48,3	48,0	46,7	**64,7**
after the project	Supply to the s/s	kWh	148002	162560	167880	125040	121360	53360	38360	29480	30480	30000	34760	59960	**1001242**
	Metered consumption	kWh	89717	124845	126158	100710	94387	44311	33386	29593	28548	26533	26464	45174	**769826**
	Electricity losses	kWh	58285	37715	41722	24330	26973	9049	4974	-113	1932	3467	8296	14786	**231416**
	Electricity losses	%	39,4	23,2	24,9	19,5	22,2	17,0	13,0	-0,4	6,3	11,6	23,9	24,7	**23,1**
	Billing	som	65492,5	93591,0	94719,4	74963,6	65245,1	32313,0	17773,5	18497,0	17004,1	15783,0	4042,7	30185,7	**529610,4**
	Collection	som	22213,6	54559,5	58408,0	75778,1	91130,2	53509,9	52059,4	26741,6	19540,8	33504,4	22835,6	18328,3	**528609,3**
	Collection rate	%	33,9	58,3	61,7	101,1	139,7	165,6	292,9	144,6	114,9	212,3	564,9	60,7	**99,8**

Comparison of the major indicators after the project vs before

before and after	Metered consumption		3,6	3,3	3,1	2,2	2,4	1,3	1,0	1,1	1,1	0,9	0,9	0,7	1,8
	Billing		4,6	3,9	3,4	2,4	2,5	1,4	0,9	1,1	1,1	0,8	0,2	0,7	1,9
	Collection		2,1	3,7	3,0	4,1	4,1	2,6	3,6	2,7	1,7	3,7	2,6	0,9	2,9

Bishkek Pilot Area: Substation # 1408

Year	Indicator	Units	Nov	Dec	Jan	Feb	March	April	May	June	July	Aug	Sep	Oct	Total
before the project	Metered consumption	kWh	2973	2835	2315	2675	2715	3523	3464	3020	2476	2337	3226	6637	**38196,0**
	Billing	som	1873,7	1820,42	1448,3	1698,5	1764,7	2381,6	2345,2	1968,7	1563,7	1421,2	2116,7	4407,7	**24810,3**
	Collection	som	3354,59	1252,74	1516,5	2313,4	2296,4	1997,1	2388,9	1245,2	2887,8	989,9	1837,2	964,7	**23044,4**
	Collection rate	%	179,0	68,8	104,7	136,2	130,1	83,9	101,9	63,2	184,7	69,7	86,8	21,9	**92,9**
after the project	Supply to the s/s	kWh	24910	39040	45840	32440	26000	13800	9880	6680	4880	4440	5920	13040	**226870,0**
	Metered consumption	kWh	10303	13012	27606	31842	29236	12525	9592	6175	4655	4231	5521	11935	**166633,0**
	Electricity losses	kWh	14607	26028	18234	598	-3236	1275	288	505	225	209	399	1105	**60237,0**
	Electricity losses	%	58,6	66,7	39,8	1,8	-12,4	9,2	2,9	7,6	4,6	4,7	6,7	8,5	**26,6**
	Billing	som	7809,3	9955,3	15733,6	19966,3	18557,7	5283,2	9502,0	4568,6	3205,4	2933,0	3830,9	6156,5	**107501,6**
	Collection	som	2936,19	5814,37	5942,1	9472,1	11636,7	13776,8	8698,8	12661,2	6507,2	4245,9	9392,5	6177,6	**97261,5**
	Collection rate	%	37,6	58,4	37,8	47,4	62,7	260,8	91,5	277,1	203,0	144,8	245,2	100,3	**90,5**

Comparison of the major indicators after the project vs before

before and after	Metered consumption		3,5	4,6	11,9	11,9	10,8	3,6	2,8	2,0	1,9	1,8	1,7	1,8	4,4
	Billing		4,2	5,5	10,9	11,8	10,5	2,2	4,1	2,3	2,0	2,1	1,8	1,4	4,3
	Collection		0,9	4,6	3,9	4,1	5,1	6,9	3,6	10,2	2,3	4,3	5,1	6,4	4,2

Bishkek Pilot Area: Substation # 1986

Year	Indicator	Units	Nov	Dec	Jan	Feb	March	April	May	June	July	Aug	Sep	Oct	Total
before the project	Metered consumption	kWh	15899	23657	30682	31087	24658	24925	18790	12635	11619	12194	14473	39229	**259848,0**
	Billing	som	9708,1	16153,34	21997,4	22149,1	17372,2	17268,0	11878,0	7210,9	6586,1	6911,4	8506,7	24149,8	**169891,0**
	Collection	som	12198,6	10563,8	11666,4	14439,2	34107,5	14910,2	11911,5	7554,8	9915,2	4429,5	4738,6	4899,7	**141334,9**
	Collection rate	%	125,7	65,4	53,0	65,2	196,3	86,3	100,3	104,8	150,5	64,1	55,7	20,3	**83,2**
after the project	Supply to the s/s	kWh	96264	134160	124800	82560	87840	44760	33720	27720	30000	27000	31320	56280	**776424,0**
	Metered consumption	kWh	48219	85662	78666	69235	62308	36597	22051	19674	18762	18029	20827	33061	**513091,0**
	Electricity losses	kWh	48045	48498	46134	13325	25532	8163	11669	8046	11238	8971	10493	23219	**263333,0**
	Electricity losses	%	49,9	36,1	37,0	16,1	29,1	18,2	34,6	29,0	37,5	33,2	33,5	41,3	**33,9**
	Billing	som	35574,2	62713,4	60009,9	52840,1	46973,0	25877,3	16620,5	14578,6	12883,6	11334,0	13024,7	22905,2	**375334,5**
	Collection	som	15714,3	15714,3	34643,0	53484,4	54960,1	22999,1	44598,3	32095,0	24971,0	35741,2	33793,0	13865,9	**382579,5**
	Collection rate	%	44,2	25,1	57,7	101,2	117,0	88,9	268,3	220,2	193,8	315,3	259,5	60,5	**101,9**

Comparison of the major indicators after the project vs before

before and after	Metered consumption		3,0	3,6	2,6	2,2	2,5	1,5	1,2	1,6	1,6	1,5	1,4	0,8	2,0
	Billing		3,7	3,9	2,7	2,4	2,7	1,5	1,4	2,0	2,0	1,6	1,5	0,9	2,2
	Collection		1,3	1,5	3,0	3,7	1,6	1,5	3,7	4,2	2,5	8,1	7,1	2,8	2,7

Bishkek Pilot Area: Substation # 2021

Year	Indicator	Units	Nov	Dec	Jan	Feb	March	April	May	June	July	Aug	Sep	Oct	Total
before the project	Metered consumption	kWh	3696	5442	6065	7036	4739	4950	4612	5648	4848	4250	4417	7992	**63695,0**
	Billing	som	2113,6	3603,1	4014,7	4696,9	3051,7	2994,6	2759,3	3579,9	2980,2	2496,4	2633,7	5928,3	**40852,3**
	Collection	som	2042,1	3272,4	3703,0	3267,3	2740,7	3638,9	3043,3	1611,3	2401,1	2199,5	2139,5	1285,1	**31344,2**
	Collection rate	%	96,6	90,8	92,2	69,6	89,8	121,5	110,3	45,0	80,6	88,1	81,2	21,7	**76,7**
after the project	Supply to the s/s	kWh	18720	27800	31400	22640	25360	11360	7360	6320	6240	6280	9440	17840	**190760,0**
	Metered consumption	kWh	14004	16703	18792	15526	20496	9141	6725	6056	6132	5425	6532	12441	**137973,0**
	Electricity losses	kWh	4716	11097	12608	7114	4864	2219	635	264	108	855	2908	5399	**52787,0**
	Electricity losses	%	25,19	39,92	40,2	31,4	19,2	19,5	8,6	4,2	1,7	13,6	30,8	30,3	**27,7**
	Billing	som	9813,9	12522,1	12026,0	10040,6	14619,4	5775,4	4364,7	3584,1	3602,8	3099,0	3887,3	10659,3	**93994,5**
	Collection	som	2825,3	5653,7	9786,4	7807,2	6933,7	8604,2	13001,9	3461,1	3108,3	6825,2	2923,5	5082,0	**76012,5**
	Collection rate	%	28,8	45,1	81,4	77,8	47,4	149,0	297,9	96,6	86,3	220,2	75,2	47,7	**80,9**

Comparison of the major indicators after the project vs before

before and after	Metered consumption		3,8	3,1	3,1	2,2	4,3	1,8	1,5	1,1	1,3	1,3	1,5	1,6	2,2
	Billing		4,6	3,5	3,0	2,1	4,8	1,9	1,6	1,0	1,2	1,2	1,5	1,8	2,3
	Collection		1,4	1,7	2,6	2,4	2,5	2,4	4,3	2,1	1,3	3,1	1,4	4,0	2,4

Bishkek Pilot Area: Substation # 1973

Year	Indicator	Units	Nov	Dec	Jan	Feb	March	April	May	June	July	Aug	Sep	Oct	Total
before the project	Metered consumption	kWh	4098	7214	7724	6755	6347	5158	4576	4439	3106	3019	3145	6823	**62404,0**
	Billing	som	2552,6	5550,2	5952,6	5240,6	4924,0	3936,5	2958,9	2884,9	1869,2	1783,9	1867,5	4345,2	**43866,0**
	Collection	som	2145,6	3608,7	4072,1	1982,2	10137,3	9027,5	1367,4	1231,7	1326,9	2772,0	568,4	5070,7	**43310,3**
	Collection rate	%	84,1	65,0	68,4	37,8	205,9	229,3	46,2	42,7	71,0	155,4	30,4	116,7	**98,7**
after the project	Supply to the s/s	kWh	62460	44460	57840	29880	36660	18540	11580	6840	8400	7500	7680	20280	**312120,0**
	Metered consumption	kWh	29025	36381	39742	28612	30928	13970	6025	6891	5677	5113	6135	11397	**219896,0**
	Electricity losses	kWh	33435	8079	18098	1268	5732	4570	5555	-51	2723	2387	1545	8883	**92224,0**
	Electricity losses	%	53,5	18,2	31,3	4,2	15,6	24,6	48,0	-0,7	32,4	31,8	20,1	43,8	**29,5**
	Billing	som	22958,7	28991,8	34343,5	22787,4	24543,3	6606,2	3998,8	4621,8	3712,9	3296,6	4032,1	8296,4	**168189,5**
	Collection	som	1169,4	17539,5	28260,7	17931,2	15639,5	20213,7	24312,8	10288,7	14258,2	3875,7	6484,8	6351,4	**166325,6**
	Collection rate	%	5,1	60,5	82,3	78,7	63,7	306,0	608,0	222,6	384,0	117,6	160,8	76,6	**98,9**

Comparison of the major indicators after the project vs before

before and after	Metered consumption		7,1	5,0	5,1	4,2	4,9	2,7	1,3	1,6	1,8	1,7	2,0	1,7	3,5
	Billing		9,0	5,2	5,8	4,3	5,0	1,7	1,4	1,6	2,0	1,8	2,2	1,9	3,8
	Collection		0,5	4,9	6,9	9,0	1,5	2,2	17,8	8,4	10,7	1,4	11,4	1,3	3,8

Bishkek Pilot Area: Totals

Year	Indicator	Units	Nov	Dec	Jan	Feb	March	April	May	June	July	Aug	Sep	Oct	Total
before the project	Metered consumption	kWh	51645	76472	88011	93640	77864	73957	64230	53344	47465	52580	55777	123639	**858624,0**
	Billing	som	30524,9	51316,6	61007,9	64854,1	53518,7	49334,9	39903,8	31821,4	28091,6	31285,1	33379,7	83793,2	**558832,1**
	Collection	som	30277,6	33447,1	40668,5	40482,1	71265,9	50462,7	33129,3	21523,4	27858,9	19414,0	18043,0	33202,9	**419775,4**
	Collection rate	%	99,2	65,2	66,7	62,4	133,2	102,3	83,0	67,6	99,2	62,1	54,1	39,6	**75,1**
after the project	Supply to the s/s	kWh	350356	408020	427760	292560	297220	141820	100900	77040	80000	75220	89120	167400	**2507416,0**
	Metered consumption	kWh	191268	276603	290964	245925	237355	116544	77779	68389	63774	59331	65479	114008	**1807419,0**
	Electricity losses	kWh	159088	131417	136796	46635	59865	25276	23121	8651	16226	15889	23641	53392	**699997,0**
	Electricity losses	%	45,4	32,2	32,0	15,9	20,1	17,8	22,9	11,2	20,3	21,1	26,5	31,9	**27,9**
	Billing	som	141648,6	207773,6	216832,3	180598,0	169938,5	75855,0	52259,4	45850,1	40408,8	36445,5	28817,6	78203,0	**1274630,5**
	Collection	som	44858,8	99281,4	137040,1	164473,0	180300,1	119103,8	142671,3	85247,5	68385,6	84192,4	75429,3	49805,3	**1250788,4**
	Collection rate	%	31,7	47,8	63,2	91,1	106,1	157,0	273,0	185,9	169,2	231,0	261,7	63,7	**98,1**

Comparison of the major indicators after the project vs before

before and after	Metered consumption		3,7	3,6	3,3	2,6	3,0	1,6	1,2	1,3	1,3	1,1	1,2	0,9	2,1
	Billing		4,6	4,0	3,6	2,8	3,2	1,5	1,3	1,4	1,4	1,2	0,9	0,9	2,3
	Collection		1,5	3,0	3,4	4,1	2,5	2,4	4,3	4,0	2,5	4,3	4,2	1,5	3,0

ANNEX 2. JSC OSHELECTRO: MAJOR INDICATORS OF INDIVIDUAL HOUSES BEFORE AND AFTER THE PROJECT

Osh Pilot Area: Substation # 479

	Indicator	Units	Dec	Jan	Feb	March	April	May	June	July	Aug	Sep	Oct	Nov	Total
before the project	Metered consumption	kWh	14510	17539	15467	17709	15242	28837	7272	5729	5745	9348	19244	15783	**172425**
	Billing	som	5803,7	8326,8	5618,0	5249,1	4071,0	8881,6	3551,2	3629,9	2482,0	2357,6	6314,2	4726,0	**61011,1**
	Collection	som	5636,6	4456,8	2334,7	4459,8	4340,6	2972,3	2949,8	4059,9	4567,9	2975,5	5382,7	4943,2	**49079,6**
	Collection rate	%	97,1	53,5	41,6	85,0	106,6	33,5	83,1	111,8	184,0	126,2	85,2	104,6	**80,4**
after the project	Supply to the s/s	kWh	47340	45060	33480	30660	25920	12360	9120	9240	10980	13620	12240	20940	**270960**
	Metered consumption	kWh	34728	31953	31686	24750	23477	9753	8441	8377	10405	12640	11148	18151	**225509**
	Electricity losses	kWh	12612	13107	1794	5910	2443	2607	679	863	575	980	1092	2789	**45451**
	Electricity losses	%	26,6	29,1	5,4	19,3	9,4	21,1	7,4	9,3	5,2	7,2	8,9	13,3	**16,8**
	Billing	som	31025,6	27884,2	27432,6	20908,2	16509,2	7018,2	5667,2	5511,7	6390,3	8332,8	8646,4	10147,4	**#######**
	Collection	som	14033,6	33300,5	18872,6	20961,0	10090,6	13246,5	3971,5	8957,8	4990,0	9087,6	6375,7	8504,5	**#######**
	Collection rate	%	45,2	119,4	68,8	100,3	61,1	188,7	70,1	162,5	78,1	109,1	73,7	83,8	**86,8**

Comparison of the major indicators after the project vs before

after vs. before	Metered consumption		2,4	1,8	2,0	1,4	1,5	0,3	1,2	1,5	1,8	1,4	0,6	1,2	**1,3**
	Billing		5,3	3,3	4,9	4,0	4,1	0,8	1,6	1,5	2,6	3,5	1,4	2,1	**2,9**
	Collection		2,5	7,5	8,1	4,7	2,3	4,5	1,3	2,2	1,1	3,1	1,2	1,7	**3,1**

Osh Pilot Area: Substation # 857

Year	Indicator	Units	Dec	Jan	Feb	March	April	May	June	July	Aug	Sep	Oct	Nov	Total
before the project	Metered consumption	kWh	6802	8806	6433	6295	8422	4848	3959	3866	3891	7252	3747	15109	**79430**
	Billing	som	4193,2	5525,7	3970,2	3702,1	5292,9	2642,4	2032,9	1846,3	1990,2	3817,9	2196,4	9880,7	**47091,0**
	Collection	som	1684,8	3982,6	3608,9	4579,4	3993,0	1977,5	2488,3	3330,1	1894,9	8589,4	3957,4	9070,1	**49156,3**
	Collection rate	%	40,2	72,1	90,9	123,7	75,4	74,8	122,4	180,4	95,2	225,0	180,2	91,8	**104,4**
after the project	Supply to the s/s	kWh	47760	34680	21720	19200	17100	9780	7740	7200	7680	7200	9000	16140	**205200**
	Metered consumption	kWh	20541	17896	13424	13178	15906	8764	7354	6960	7459	6909	8651	14602	**141644**
	Electricity losses	kWh	27219	16784	8296	6022	1194	1016	386	240	221	291	349	1538	**63556**
	Electricity losses	%	57,0	48,4	38,2	31,4	7,0	10,4	5,0	3,3	2,9	4,0	3,9	9,5	**31,0**
	Billing	som	14499,2	12543,4	8989,3	8855,4	8764,5	4792,6	3922,0	3627,0	3876,2	3591,5	4890,7	8924,8	**87276,4**
	Collection	som	7484,6	6061,1	3810,4	11993,6	5536,0	4142,8	3159,1	4027,9	4333,0	3548,8	4386,7	5652,6	**64136,5**
	Collection rate	%	51,6	48,3	42,4	135,4	63,2	86,4	80,5	111,1	111,8	98,8	89,7	63,3	**73,5**

Comparison of the major indicators after the project vs before

after vs. before	Metered consumption		3,0	2,0	2,1	2,1	1,9	1,8	1,9	1,8	1,9	1,0	2,3	1,0	**1,8**
	Billing		3,5	2,3	2,3	2,4	1,7	1,8	1,9	2,0	1,9	0,9	2,2	0,9	**1,9**
	Collection		4,4	1,5	1,1	2,6	1,4	2,1	1,3	1,2	2,3	0,4	1,1	0,6	**1,3**

Osh Pilot Area: Substation # 1045

Year	Indicator	Units	Dec	Jan	Feb	March	April	May	June	July	Aug	Sep	Oct	Nov	Total
before the project	Metered consumption	kWh	640	1674	1205	1010	1411	1268	1538	731	1289	1473	1440	2420	**16099**
	Billing	som	286,2	734,2	363,0	322,9	538,6	388,3	507,5	253,0	396,0	426,2	554,2	1365,9	**6136,0**
	Collection	som	199,7	489,8	1926,6	429,6	563,3	315,9	533,5	590,4	465,4	714,9	954,3	550,0	**7733,4**
	Collection rate	%	69,8	66,7	530,8	133,0	104,6	81,4	105,1	233,3	117,5	167,7	172,2	40,3	**126,0**
after vs. before	Supply to the s/s	kWh	5559	6025	5489	4855	3738	1891	1430	1445	1386	2039	1882	3346	**39085**
	Metered consumption	kWh	5290	5336	5089	3337	3146	1463	1381	1407	1339	1865	1592	3046	**34291**
	Electricity losses	kWh	269	689	400	1518	592	428	49	38	47	174	290	300	**4794**
	Electricity losses	%	4,8	11,4	7,3	31,3	15,8	22,6	3,4	2,6	3,4	8,5	15,4	9,0	**12,3**
	Billing	som	4095,1	4142,3	3882,7	2390,5	2107,5	783,7	695,9	731,7	686,7	1076,3	895,2	2008,2	**23495,7**
	Collection	som	945,0	366,3	0,0	3298,5	240,4	1622,0	0,0	2181,7	650,1	1634,6	971,2	884,7	**12794,4**
	Collection rate	%	23,1	8,8	0,0	138,0	11,4	207,0	0,0	298,2	94,7	151,9	108,5	44,1	**54,5**

Comparison of the major indicators after the project vs before

after vs. before	Metered consumption		8,3	3,2	4,2	3,3	2,2	1,2	0,9	1,9	1,0	1,3	1,1	1,3	**2,1**
	Billing		14,3	5,6	10,7	7,4	3,9	2,0	1,4	2,9	1,7	2,5	1,6	1,5	**3,8**
	Collection		4,7	0,7	0,0	7,7	0,4	5,1	0,0	3,7	1,4	2,3	1,0	1,6	**1,7**

Osh Pilot Area: Substation # 1082

Year	Indicator	Units	Dec	Jan	Feb	March	April	May	June	July	Aug	Sep	Oct	Nov	Total
before the project	Metered consumption	kWh	1611,0	4981	8672	7573	8421	7381	5317	6105	3353	4155	5423	8325	**71317**
	Billing	som	842,8	1558,1	1236,8	838,2	1278,5	776,9	1745,2	549,4	501,3	1229,8	1894,3	4451,3	**16902,8**
	Collection	som	748,8	923,7	524,2	698,9	299,5	550,0	825,0	800,0	600,0	1200,0	1075,0	1469,0	**9714,1**
	Collection rate	%	88,8	59,3	42,4	83,4	23,4	70,8	47,3	145,6	119,7	97,6	56,8	33,0	**57,5**
after vs. before	Supply to the s/s	kWh	15120	10440	6515	7440	6840	6300	4980	3900	4200	3720	4200	6000	**79655**
	Metered consumption	kWh	7855	8215	6136	6803	6576	6180	4799	3745	4041	3735	4010	5424	**67519**
	Electricity losses	kWh	7265	2225	379	637	264	120	181	155	159	-15	190	576	**12136**
	Electricity losses	%	48,0	21,3	5,8	8,6	3,9	1,9	3,6	4,0	3,8	-0,4	4,5	9,6	**15,2**
	Billing	som	6003,9	6650,0	4614,24	5156,3	4548,1	4753,8	3402,3	2474,2	2722,3	2421,8	2288,0	3709,9	**48744,7**
	Collection	som	3029,5	4748,0	1599,99	6421,0	2169,0	324,9	5176,2	6604,1	2305,9	2808,1	2906,7	2478,1	**40571,5**
	Collection rate	%	50,5	71,4	34,7	124,5	47,7	6,8	152,1	266,9	84,7	116,0	127,0	66,8	**83,2**

Comparison of the major indicators after the project vs before

after vs. before	Metered consumption		4,9	1,6	0,7	0,9	0,8	0,8	0,9	0,6	1,2	0,9	0,7	0,7	**0,9**
	Billing		7,1	4,3	3,7	6,2	3,6	6,1	1,9	4,5	5,4	2,0	1,2	0,8	**2,9**
	Collection		4,0	5,1	3,1	9,2	7,2	0,6	6,3	8,3	3,8	2,3	2,7	1,7	**4,2**

Osh Pilot Area: Substation # 1216

Year	Indicator	Units	Dec	Jan	Feb	March	April	May	June	July	Aug	Sep	Oct	Nov	Total
before the project	Metered consumption	kWh	686	4995	1898	1874	1508	1321	1507	1216	1178	2946	2075	2917	**24121**
	Billing	som	208,4	3106,8	814,4	949,2	661,5	469,5	667,8	472,1	252,4	1475,1	565,1	1627,7	**11270,1**
	Collection	som	573,1	731,0	1416,6	1174,3	785,0	200,0	557,2	450,0	403,9	969,0	600,0	1164,2	**9024,3**
	Collection rate	%	275,0	23,5	173,9	123,7	118,7	42,6	83,4	95,3	160,0	65,7	106,2	71,5	**80,1**
after vs. before	Supply to the s/s	kWh	9280	6440	5265	6200	6140	3480	2520	2200	2080	2520	2920	4040	**53085**
	Metered consumption	kWh	4221	4359	3850	4381	4817	3043	2384	2119	1806	2120	2817	3610	**39527**
	Electricity losses	kWh	5059	2081	1415	1819	1323	437	136	81	274	400	103	430	**13558**
	Electricity losses	%	54,5	32,3	26,9	29,3	21,5	12,6	5,4	3,7	13,2	15,9	3,5	10,6	**25,5**
	Billing	som	3100,4	3094,7	2696,0	3110,9	3300,8	1887,3	1149,3	1302,2	1050,2	1313,7	1789,2	2109,4	**25904,0**
	Collection	som	552,0	3285,0	600,0	4023,2	1328,1	2140,6	1334,9	1315,0	809,3	1530,0	2557,6	1165,5	**20641,3**
	Collection rate	%	106,1	106,1	22,3	129,3	40,2	113,4	116,2	101,0	77,1	116,5	142,9	55,3	**79,7**

Comparison of the major indicators after the project vs before

after vs. before	Metered consumption		6,2	0,9	2,0	2,3	3,2	2,3	1,6	1,7	1,5	0,7	1,4	1,2	**1,6**
	Billing		14,9	1,0	3,3	3,3	5,0	4,0	1,7	2,8	4,2	0,9	3,2	1,3	**2,3**
	Collection		1,0	4,5	0,4	3,4	1,7	10,7	2,4	2,9	2,0	1,6	4,3	1,0	**2,3**

Osh Pilot Area: Substation # 546

Year	Indicator	Units	Dec	Jan	Feb	March	April	May	June	July	Aug	Sep	Oct	Nov	Total
before the project	Metered consumption	kWh	5181	4670	6950	9707	10019	10510	12476	14009	17802	21571	18159	50023	**181077**
	Billing	som	708,6	526,9	625,1	1048,0	709,2	1423,7	690,4	636,8	461,6	1539,9	1072,5	1534,4	**10977,0**
	Collection	som	652,1	875,3	597,8	336,7	601,3	821,1	937,1	1168,4	995,2	124,9	1676,5	1435,0	**10221,3**
	Collection rate	%	92,0	166,1	95,6	32,1	84,8	57,7	135,7	183,5	215,6	8,1	156,3	93,5	**93,1**
after vs. before	Supply to the s/s	kWh	18150	14340	8730	6840	5370	6580	6210	5100	3180	2550	2640	3940	**83630**
	Metered consumption	kWh	11362	9644	7679	6011	4977	6205	5819	4962	3069	2515	2952	3908	**69103**
	Electricity losses	kWh	6788	4696	1051	829	393	375	391	138	111	35	-312	32	**14527**
	Electricity losses	%	37,4	32,7	12,0	12,1	7,3	5,7	6,3	2,7	3,5	1,4	-11,8	0,8	**17,4**
	Billing	som	6851,5	6123,3	4931,2	2812,2	3312,8	3666,6	3399,4	2882,1	1739,0	1683,0	2500,8	2429,1	**42330,9**
	Collection	som	5710,0	7078,2	3924,8	1871,5	3312,2	2611,1	3371,8	3277,6	1538,5	1272,9	1903,8	2688,6	**38561,0**
	Collection rate	%	83,3	115,6	79,6	66,5	100,0	71,2	99,2	113,7	88,5	75,6	76,1	110,7	**91,1**

Comparison of the major indicators after the project vs before

after vs. before	Metered consumption		2,2	2,1	1,1	0,6	0,5	0,6	0,5	0,4	0,2	0,1	0,2	0,1	**0,4**
	Billing		9,7	11,6	7,9	2,7	4,7	2,6	4,9	4,5	3,8	1,1	2,3	1,6	**3,9**
	Collection		8,8	8,1	6,6	5,6	5,5	3,2	3,6	2,8	1,5	10,2	1,1	1,9	**3,8**

Osh Pilot Area: Totals

Year	Indicator	Units	Dec	Jan	Feb	March	April	May	June	July	Aug	Sep	Oct	Nov	Total
before the project	Metered consumption	kWh	29430	42665	40625	44168	45023	54165	32069	31656	33258	46745	50088	94577	**544469**
	Billing	som	12043,0	19778,4	12627,4	12109,6	12551,8	14582,4	9195,04	7387,57	6083,59	10846,4	12596,8	23586,1	#######
	Collection	som	9495,0	11459,2	10408,8	11678,7	10582,6	6836,71	8290,98	10398,7	8927,28	14573,6	13646	18631,4	#######
	Collection rate	%	78,8	57,9	82,4	96,4	84,3	46,9	90,2	140,8	146,7	134,4	108,3	79,0	**88,0**
after vs. before	Supply to the s/s	kWh	143209	116985	81199	75195	65108	40391	32000	29085	29506	31649	32882	54406	**731615**
	Metered consumption	kWh	83997	77403	67864	58460	58899	35408	30178	27570	28119	29784	31170	48741	**577593**
	Electricity losses	kWh	59212	39582	13335	16735	6209	4983	1822	1515	1387	1865	1712	5665	**154022**
	Electricity losses	%	41,3	33,8	16,4	22,3	9,5	12,3	5,7	5,2	4,7	5,9	5,2	10,4	**21,1**
	Billing	som	65575,5	60437,9	52545,9	43233,6	38542,9	22902,2	18235,9	16528,8	16464,6	18419,1	21010,2	29328,8	#######
	Collection	som	31754,6	54839	28807,8	48568,7	22676,2	24087,9	17013,5	26364,1	14626,8	19882,1	19101,7	21374	#######
	Collection rate	%	48,4	90,7	54,8	112,3	58,8	105,2	93,3	159,5	88,8	107,9	90,9	72,9	**81,6**

Comparison of the major indicators after the project vs before

after vs. before	Metered consumption		2,9	1,8	1,7	1,3	1,3	0,7	0,9	0,9	0,8	0,6	0,6	0,5	**1,1**
	Billing		5,4	3,1	4,2	3,6	3,1	1,6	2,0	2,2	2,7	1,7	1,7	1,2	**2,6**
	Collection		3,3	4,8	2,8	4,2	2,1	3,5	2,1	2,5	1,6	1,4	1,4	1,1	**2,4**

ANNEX 3. JSC SEVERELECTRO: MAJOR INDICATORS FOR APARTMENT BUILDINGS

Bishkek Pilot Area: Apartment building with replaced metering system

Year	Indicator	Units	Jan	Feb	March	April	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
2003	Metered consumption	kWh	16023	15319	14500	14480	16203	13421	11075	11727	12329	24489	18486	19816	187868
	Billing	som	8731,6	8416,2	7882,9	7727,1	8841,8	6939,0	5449,7	5755,1	6048,5	12981,4	10606,3	11381,6	100761,2
	Collection	som	8329,3	8884,6	6330,8	8328,6	7088,9	6893,4	7356,1	6789,9	5426,0	7032,6	7311,4	10104,0	89875,6
	Collection rate	%	95,4	105,6	80,3	107,8	80,2	99,3	135,0	118,0	89,7	54,2	68,9	88,8	89,2
2004	Supply to the s/s	kWh	18990	18150	17910	14850	15150	15330	12750	12390	14190	18210	17850	21060	196830,0
	Metered consumption	kWh	18592	16781	16864	14483	14779	14960	12721	11912	14181	17544	17229	20084	190130,0
	Electricity losses	kWh	398	1369	1046	367	371	370	29	478	9	666	621	976	6700,0
	Electricity losses	%	2,1	7,5	5,8	2,5	2,4	2,4	0,2	3,9	0,1	3,7	3,5	4,6	3,4
	Billing	som	10385,4	9369,0	8901,4	7539,3	7695,7	7801,3	6234,2	5824,3	6972,4	9761,5	9315,5	11440,4	101240,4
	Collection	som	10398,6	11036,4	10206,9	8854,1	11213,2	6270,5	7764,8	5747,3	5901,0	7449,3	11140,2	7809,8	103792,1
	Collection rate	%	100,1	117,8	114,7	117,4	145,7	80,4	124,6	98,7	84,6	76,3	119,6	68,3	102,5

Comparison of the major indicators 2004 vs 2003

2004 vs. 2003	Metered consumption		1,2	1,1	1,2	1,0	0,9	1,1	1,1	1,0	1,2	0,7	0,9	1,0	1,01
	Billing		1,2	1,1	1,1	1,0	0,9	1,1	1,1	1,0	1,2	0,8	0,9	1,0	1,00
	Collection		1,2	1,2	1,6	1,1	1,6	0,9	1,1	0,8	1,1	1,1	1,5	0,8	1,15

Bishkek Pilot Area: Apartment building without meter replacement

Year	Indicator	Units	Jan	Feb	March	April	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
2004	Supply to the s/s	kWh	31830	27960	23010	24210	22890	22560	21120	19860	18780	20760	27240	27990	288210,0
	Metered consumption	kWh	28399	24766	20410	22240	21348	21161	20089	18506	17459	18980	24927	24078	262363,0
	Electricity losses	kWh	3431	3194	2600	1970	1542	1399	1031	1354	1321	1780	2313	3912	25847,0
	Electricity losses	%	10,8	11,4	11,3	8,1	6,7	6,2	4,9	6,8	7,0	8,6	8,5	14,0	9,0
	Billing	som	16236,8	13461,2	10674,7	11606,6	10663,9	11244,2	10228,2	8807,6	8363,1	9418,4	13533,2	13027,2	137265,2
	Collection	som	30754,2	5558,9	7295,4	8626,9	11580,5	10759,9	7680,1	7329,1	9083,6	8463,0	12879,7	12415,7	132427,1
	Collection rate	%	189,4	41,3	68,3	74,3	108,6	95,7	75,1	83,2	108,6	89,9	95,2	95,3	96,5

ANNEX 4. JSC OSHELECTRO: MAJOR INDICATORS FOR APARTMENT BUILDINGS

Osh Pilot Area: Apartment Building with Replaced Metering System

Year	Indicator	Units	Jan	Feb	March	April	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
2003	**Metered consumption**	kWh	18757	16302	28754	15312	15179	10169	10430	11841	11841	9508	28611	39947	**216651**
	Billing	som	11102,4	9397,0	16874,4	8605,8	8134,4	4967,6	4906,6	5899,7	5899,7	4640,2	17716,0	27321,9	**125465,6**
	Collection	som	10784,5	9737,6	6836,2	11857,0	4442,8	8030,7	9087,7	6743,0	6743,0	5242,5	16419,0	24956,9	**120880,9**
	Collection rate	%	97,1	103,6	40,5	137,8	54,6	161,7	185,2	114,3	114,3	113,0	92,7	91,3	**96,3**
2004	**Supply to the s/s**	kWh	59460	34200	31380	29580	20040	15000	13760	14610	15060	16500	32040	37500	**319130**
	Metered consumption	kWh	52841	33660	28809	28942	19648	14983	13364	14264	14679	14866	31809	36526	**304391**
	Electricity losses	kWh	6619	540	2571	638	392	17	396	346	381	1634	231	974	**14739**
	Electricity losses	%	11,1	1,6	8,2	2,2	2,0	0,1	2,9	2,4	2,5	9,9	0,7	2,6	**4,6**
	Billing	som	37909,4	22939,9	19004,6	18259,0	10843,4	7776,4	6213,2	7283,4	7900,2	9056,2	14185,0	18127,8	**179498,5**
	Collection	som	20497,9	8392,5	9840,2	15333,9	18541,9	11216,9	16811,2	11799,8	11974,4	11517,0	10183,7	18737,0	**164846,2**
	Collection rate	%	54,1	36,6	51,8	84,0	171,0	144,2	270,6	162,0	151,6	127,2	71,8	103,4	**91,8**

Comparison of the major indicators 2004 vs 2003

2004 vs. 2003	**Metered consumption**		2,8	2,1	1,0	1,9	1,3	1,5	1,3	1,2	1,2	1,6	1,1	0,9	1,4
	Billing		3,4	2,4	1,1	2,1	1,3	1,6	1,3	1,2	1,3	2,0	0,8	0,7	1,4
	Collection		1,9	0,9	1,4	1,3	4,2	1,4	1,8	1,7	1,8	2,2	0,6	0,8	1,4

Osh Pilot Area: Apartment Building without Meter Replacement

Year	Indicator	Units	Jan	Feb	March	April	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
2004	**Supply to the s/s**	kWh	13400	7600	4800	13800	13200	4535	4880	5250	5300	9800	5600	16674	**104839**
	Metered consumption	kWh	10154	6551	4659	9021	10764	3857	3404	3135	4664	8424	4715,2	14399	**83747,2**
	Electricity losses	kWh	3246	1049	141	4779	2436	678	1476	2115	636	1376	884,8	2275	**21092**
	Electricity losses	%	24,2	13,8	2,9	34,6	18,5	15,0	30,2	40,3	12,0	14,0	15,8	13,6	**20,1**
	Billing	som	6359,8	3725,3	2722,0	9928,8	9236,9	1776,0	2934,6	1585,1	3731,2	5115,3	4571,7	8164,0	**59850,6**
	Collection	som	4152,7	2717,1	2516,7	5225,2	3473,1	3427,3	4018,9	2338,3	769,2	1144,1	1707,4	4395,3	**35885,3**
	Collection rate	%	65,3	72,9	92,5	52,6	37,6	193,0	137,0	147,5	20,6	22,4	37,3	53,8	**60,0**

ANNEX 5. ECONOMIC ASSESSMENT OF BISHKEK PILOT AREA

Input Data		
Initial investments	som	1797460,5
Time of analysis	years	10
Collections after the project	som	1274630,49
Collections before the project	som	419775,4
Annual additional revenue	som	854855,1
Exchange rate	som/USD	41
1. Simple payback period	years	**2,1**
2. Internal Rate of Return	**%**	**44%**

Period of analysis	Collection rate (%)	Net Cash Flow	Cumulative cash flow
Initial investments		-1797440,00	
1	100	854855,1	854855,1
2	90	769369,6	1624224,6
3	91	777918,1	2402142,7
4	92	786466,7	3188609,4
5	93	795015,2	3983624,6
6	94	803563,8	4787188,3
7	95	812112,3	5599300,6
8	95	812112,3	6411413,0
9	95	812112,3	7223525,3
10	95	812112,3	8035637,6

Bishkek Pilot Area: Apartment Buildings

Initial investments	som	658775,7
Collections after the project	som	103792,05
Collections before the project	som	89875,6
Annual additional revenue	som	13916,5
Exchange rate	som/USD	41
1. Simple payback period	years	**47,3**

ANNEX 6. ECONOMIC ASSESSMENT OF OSH PILOT AREA

Input Data

Initial investments	som	1106372,7
Time of analysis	years	10
Collections after the project	som	403225,44
Collections before the project	som	134928,9
Annual additional revenue	som	268296,6
Exchange rate	som/USD	41

1.	**Simple payback period**	years	**4,1**
2.	**Internal Rate of Return**	%	**19%**

Period of analysis	Collection rate (%)	Net Cash Flow	Cumulative cash flow
Initial investments		-1106372,7	
1	100	268296,6	268296,6
2	90	241466,9	509763,5
3	91	244149,9	753913,4
4	92	246832,9	1000746,2
5	93	249515,8	1250262,1
6	94	252198,8	1502460,8
7	95	254881,8	1757342,6
8	95	254881,8	2012224,4
9	95	254881,8	2267106,1
10	95	254881,8	2521987,9

Osh Pilot Area: Apartment Buildings

Initial investments	som	793694,4
Collections after the project	som	179498,5
Collections before the project	som	120880,9
Annual additional revenue	som	58617,6
Exchange rate	som/USD	41

1.	**Simple payback period**	years	**13,5**

ANNEX 7. SELECTED PHOTOGRAPHS